TANDBERG SLR

Tandberg SLR7, SLR50, SLR60, SLR75, SLR100, SLR140

SCSI INTERFACE FUNCTIONAL SPECIFICATION

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We would appreciate any comments on this publication.

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1. Introduction

1.1. General

This manual covers the SCSI Specifications for the Tandberg SLR Product Line Tape Drives. Currently there are six available models:

- Tandberg SLR140
- Tandberg SLR100
- Tandberg SLR75
- Tandberg SLR60
- Tandberg SLR50
- Tandberg SLR7

This manual replaces Part no. 430743–12, titled, “*Tandberg SLR7, SLR50, SLR60, SLR75, SLR100. SCSI Interface Functional Specification.*”

The main differences between the five models are capacity, data transfer rate and the medium types supported. The following table shows the different capacities and read/write compatibility for the various drive models.

Medium Type[1]	Capacity[2]	SLR7	SLR50	SLR60	SLR75	SLR100	SLR140
SLRtape140	70/140 Gbyte	N/A	N/A	N/A	N/A	N/A	Read/Write
SLRtape100	50/100 Gbyte	N/A	N/A	N/A	N/A	Read/Write	Read/Write
SLRtape75	38/75 Gbyte	N/A	N/A	Read/Write	Read/Write	Read/Write	Read/Write
SLRtape60	30/60 Gbyte	N/A	N/A	Read/Write	Read/Write	Read/Write	Read/Write
SLRtape50	25/50 Gbyte	N/A	Read/Write	Read/Write	Read/Write	Read/Write	Read/Write
SLRtape40	20/40 Gbyte	N/A	N/A	Read/Write	Read/Write	Read/Write	Read/Write
SLRtape7	20/40 Gbyte	Read/Write	N/A	Read	Read	Read	Read
SLR32	16/32 Gbyte	N/A	Read/Write	Read	Read	Read	N/A
SLRtape24	12/24 Gbyte	N/A	Read/Write	Read	Read	Read	N/A
SLR5	4/8 Gbyte	Read	Read	Read	Read	N/A	N/A
DC9250	2.5/5 Gbyte	N/A	Read	Read[3]	Read	N/A	N/A

Table 1-1: Capacity and medium types

If a certain functional specification is valid for a particular drive, two methods are used to separate the different specifications throughout this manual:

1) The specific functional specification is marked out with horizontal lines, or

2) Footnotes are used to indicate for which drive the specification applies.

The specifications described in this publication are subject to change without notice.

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[1] All drives supports different variants of these medium types. See table 30-3 for details.
[2] The highest number is with 2:1 data compression. The actual capacity on brand new or old and worn tapes may be lower.
[3] On SLR60 tape drives with MAN. DATE 2802 (July 2002) or higher.

1.2. Overview

Chapter 2	Describes tape streamers in general and the Tandberg SLR Product Line Tape Drives in particular. The chapter also describes volume partitioning, the overwrite function, the usage of fixed and variable length data blocks, the data buffer system and data compression.
Chapter 3	Gives a description of the SCSI logical characteristics as implemented by the Tandberg SLR Product Line Tape Drives.
Chapter 4	Specifies the SCSI Command Descriptor Blocks (CDB) in general.
Chapter 5	Lists the Status Bytes implemented by the Tandberg SLR Product Line Tape Drives.
Chapter 6	Describes the SCSI Message system as implemented by the Tandberg SLR Product Line Tape Drives.
Chapter 7	Specifies the Tandberg SLR Product Line Tape Drives exception handling in general.
Chapters 8 - 32	Detailed specifications of the SCSI commands.

1.3. Glossary

BOM	**Beginning Of Medium.** The extreme position along the medium in the direction *from* the supply-reel, which can be accessed by the use of a REWIND command.
BOP	**Beginning Of Partition.** The position at the beginning of the permissible recording region of a partition. If only one partition is defined, this position is equivalent to BOM (see above).
BOT	**Beginning Of Tape.** Physical marker on the tape marking the start of the useful area of the tape (located at BOM, see above).
CDB	**Command Descriptor Block.** The structure used to communicate commands from an Initiator to a Target.
Compression Block Group	A group of compressed data recorded as one variable length block. The Compression Block Group either contains a number of host-defined logical fixed length blocks, or a complete or partial host-defined variable length logical block. The Compression Block Group also contains a Compression Header as its initial sequence of data.
Compression Header	A sequence of uncompressed data at the beginning of each Compression Block Group. The Compression Header contains specific information related to this Compression Block Group.
Disconnect	The action that occurs when a SCSI device releases control of the SCSI-bus, allowing it to go to the BUS FREE phase.
EOD	**End Of Data.** A tape format specific end-of-data indication on the current partition. The recording medium may be positioned at EOD by reading until the Drive signals an EOD exception or by issuing a SPACE command with a Space Code of 3 (*Space to End-Of-Data*).
EOM	**End Of Medium.** The extreme position along the medium in the direction *from* the take-up-reel, which can be accessed by the device. This position may be accessed by the use of a LOAD/UNLOAD command with the EOT-bit set to one.
EOP	**End Of Partition.** The position at the end of the permissible recording area of a partition. If only one partition is defined, this position is equivalent to EOM (see above).
EOT	**End Of Tape.** Physical marker on the tape marking the end of the useful area of the tape (located at EOM, see above).
EW	**Early Warning.** Physical tape-mark near - but logically before - EOP (independent of physical direction).
Field	A group of one or more contiguous bits. Fields containing only one bit are usually referred to as the XX bit instead of the XX field.
Initiator	SCSI-bus Device issuing SCSI commands to a SCSI Target.
LED	**Light Emitting Diode.** An indicator on the front of the Drive.
LEW	**Logical Early Warning.** Simulated EW marker on the last track on each partition. LEW is moved some distance in front of the actual EW.
LSB	**Least Significant Bit.**
LUN	**Logical Unit Number.**
MLR	**Multi Channel Linear Recording.**
MSB	**Most Significant Bit.**

Overlength	The incorrect length condition that exists after executing a read group command, when the length of the actual block read exceeds the requested transfer length in the command descriptor block (CDB).
Page	Several commands use regular parameter structures that are referred to as pages. These pages are identified with a value known as a page code.
Parameter	A structure containing one or more fields.
Partition	The entire region of recording and reading paths in a volume or in a portion of a volume.
Reconnect	The act of re-establishing the physical Initiator/Target connection. A Target reconnects to an Initiator by issuing RESELECTION and MESSAGE IN phases after winning arbitration.
Reserved	The term used for bits, fields and code values that are set aside for future standardization.
SCSI	**Small Computer Systems Interface.** Industry standard computer peripheral interface. Used to connect several devices via a common data and control bus.
SCSI address	The representation of the unique address (0-7) assigned to a SCSI device. This address would normally be assigned and set in the SCSI device during system initialization.
SCSI ID	The bit-significant representation of the SCSI address referring to one of the SCSI-bus data lines.
Signal assertion	The act of driving a signal to the true state.
Signal de-assertion	The act of driving a signal to the false state.
SLR	**Scaleable Linear Recording.**
Status	One byte of information sent from a Target to an Initiator upon completion of each command.
Third-party	When used in reference to RESERVE or RELEASE commands, third-party means a reservation made on behalf of another device.
Target	SCSI-bus Device receiving/executing SCSI commands.
TLA	**Three Letter Acronym.**
Track Set	A logical collection of N physical tracks which are written or read simultaneously. A track set can be viewed as a logical track that holds N times as much data as a physical track and can transfer data N times as fast as a physical track. A track set may consist of only a single track, i.e. N = 1.
Underlength	The incorrect length condition that exists after executing a read group command when the requested transfer length in the command descriptor block (CDB) exceeds the length of the actual block read.
Volume	A recording medium together with its physical carrier.

1.4. Additional Reference Documentation

[1] Tandberg Data ASA, “ Tandberg SLR Product Line Reference Manual” , Revision 6, Publ. No. 9031-6, December 1999.

[2] American National Standards Institute, “ SCSI-2, Enhanced Small Computer System Interface” , ANSI Standard X3.131-1994.

[3] American National Standards Institute, “ SCSI-3, Primary Commands” , ANSI Working Draft X3T10/995D, Revision 11a, 28 March 1997.

[4] American National Standards Institute, “ SCSI-3 Stream Device Command Set” , ANSI Working Draft X3T10/997D, Revision 22, 1-Jan-2000.

[5] American National Standards Institute, “ SCSI-3 Interlocked Protocol” , ANSI Working Draft X3T10/856D, Revision 10, 31 Mar 1996.

[6] American National Standards Institute, “ SCSI-3 Parallel Interface” , ANSI Working Draft X3T10/855D, Revision 15a.
American National Standards Institute, “ SCSI-3 Parallel Interface 2” , ANSI Working Draft X3T10/855D, Revision 20b.

[7] QIC, “ Development Standard For 1/4-inch Cartridge Tape Drive SCSI-2 Interface” , QIC-121, Revision P, 14-Dec-1995.

[8] QIC, “ Adaptive Lossless Data Compression” , QIC-154, Revision A, 10-Mar-1994.

[9] QIC, “ Serial Recorded Magnetic Tape Cartridge For Information Interchange” , QIC-2GB-DC, Revision B, 10-Mar-1994.

[10] QIC, “ Serial Recorded Magnetic Tape Cartridge For Information Interchange” , QIC-4GB-DC, Revision B, 20-Apr-1997.

[11] Tandberg Data ASA, “ Serial Recorded Magnetic Tape Cartridge For Information Interchange” , SLR6 Tape Format, Revision A, 1998.

[12] QIC, “ Serial Recorded Magnetic Tape Cartridge For Information Interchange” , QIC-5010-DC, Revision E, 15-Dec-1994.

[13] Tandberg Data ASA, “ Serial Recorded Magnetic Tape Cartridge For Information Interchange” , MLR3 Tape Format, Revision A, 30-Aug-1995.

[14] Tandberg Data ASA, “ Advanced Linear Recording Format 1” , ALRF-1, Revision B, 22-Apr-1998.

[15] QIC, “ Serial Recorded Magnetic Tape Cartridge For Information Interchange” , QIC-CRF1, Revision J, 15 Jun 1995.

[16] Tandberg Data ASA, “ Advanced Linear Recording Format 2” , ALRF-2, Revision 1. 24-Apr-2000.

[17] Tandberg Data ASA, “ Advanced Linear Recording Format 6” , ALRF-6, Revision 2.00-Oct-2002

[18] American National Standards Institute, “ SCSI-3 Fast-20” , ANSI Working Draft X3T10/1071D, Revision 6.

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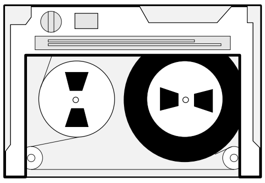
2. About Tape Streamers

2.1. Physical Elements

Tape streamer devices optimize their use in storing or retrieving user data in a sequential manner. Since access is sequential, position changes typically take long time, when compared to direct-access devices like disks.

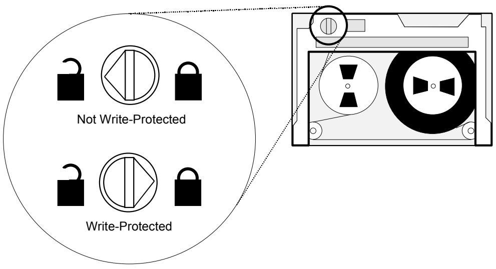


The recording medium used with the Drive consists of a flexible substrate coated with a magnetic material. The recording medium is wound onto two reels.

Both the supply reel and the take-up reel are encapsulated into a cartridge. Several standards exist, covering the construction of cartridges for interchange.

A complete unit composed of the recording medium and its physical carrier (the cartridge) is called a *volume*. In tape streamers like the Tandberg SLR Product Line Tape Drives, the volumes are removable.

When a volume is inserted it has the attribute of being loaded or unloaded. Loaded is the state when the streamer device is capable of executing commands that cause the medium to be moved (so-called media access commands). A volume is unloaded when the media access commands can not be executed (that is when these commands report CHECK CONDITION status and a NOT READY sense key).



The *write-protected* state determines whether an Initiator may or may not write information on a volume. This attribute is controlled by the user of the volume through the SAFE-switch on the cartridges.

The recording medium has two physical attributes called *Beginning-Of-Tape* (BOT) and *End-Of-Tape* (EOT). BOT is at the end of the medium that is attached to the take-up reel. EOT is at the end of the medium that is attached to the supply reel.

2.2. Data Storage Characteristics

Serpentine Recording Method

The position on the medium where a pattern of recorded signal may be written by one write component is called a *track* or *track set* which may consist of either one, two or four tracks, depending on the tape format used. On a new volume, recording of a track set begins after mounting the volume and then by moving the tape from BOT toward EOT. When EOT is approached, the direction of recording is reversed and the Drive starts recording a track set from EOT towards BOT. This process repeats the number of times necessary to record all track sets. The total number of track sets depends on the tape format used. This method of recording is called *serpentine*.

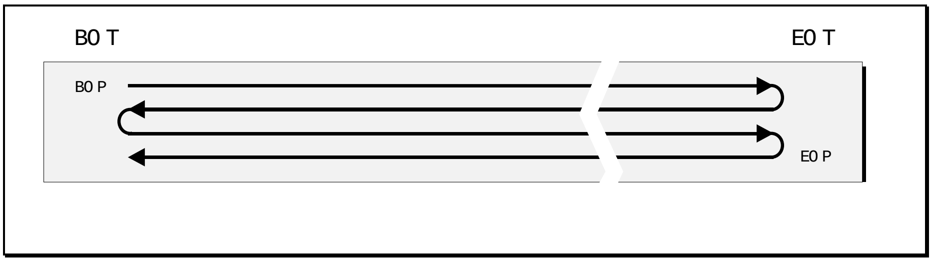


Figure 2-1: Serpentine Recording

A track set is read in the same sequence as when writing.

When reading data using a DC9250, SLR5 or SLRtape7 medium, the drive is aided by reference tracks to position the read/write head accurately.

For the DC9250 and SLR5 media the drive[1], writing these tapes from BOT, has to provide the tape with the required reference bursts during write. The writing and reading of reference bursts are done automatically by the drive and are completely transparent to the user.

The reference bursts are pre-recorded on SLRtape7 media. The reading of reference bursts are done automatically by the drive and are completely transparent to the user.

On the other hand, SLRtape140, SLRtape100, SLRtape75, SLRtape60, SLRtape50, SLRtape40, SLR32 and SLRtape24 media have pre-recorded *servo tracks*, and the reading and writing of reference bursts are therefore not required. The servo tracks are used to position the read/write head both during the read and write operations. The reader should be aware of this distinction when meeting the term “reference bursts” later in this manual. See [9] – [17] for further information on reference bursts and servo tracks.

From the Initiators point of view the recording medium may be looked upon as having a single large continuous logical track starting with an area called *Beginning-Of-Media* (BOM) and ending with an area called *End-Of-Media* (EOM). BOM is always on the same side of the volume as BOT. EOM may be located at the BOT or at the EOT depending on whether the total number of track sets is odd or even.

The logical track is split into several areas separated by markers. At least four parts may be identified:

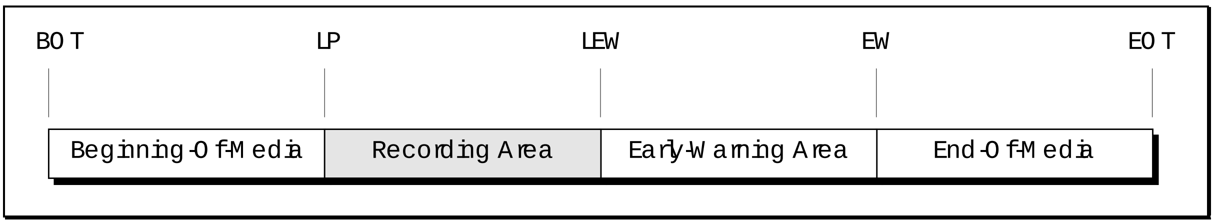


Figure 2-2: Logical Track Areas

[1] Drives covered by this manual can only read DC9250 and SLR5 media.

Beginning-Of-Media

This area holds no user data. It is used to record a special reference burst as defined in [9], [10]. This area starts with the BOT (Beginning Of Tape) tape marker and ends at the LP (Load Point) tape marker.

Recording Area

This area holds the user data. This area starts with the LP (Load Point) tape marker and ends at the LEW (Logical Early Warning) marker.

Early-Warning Area

When writing, the Initiator needs an indication that it is approaching the end of the Recording-Area. This position called Logical Early Warning (LEW) is reported to the Initiator at a position early enough for the Drive to write out any buffered data to the medium while still leaving enough room for additional recorded data or tapemarks. The actual amount of data is user configurable, see the LEW Position field in Section 14.3.9. This area ends at the EW (Early Warning) tape marker.

End-Of-Media

This is the short area between the EW (Early Warning) and the EOT (End-Of-Tape) tape markers. It is usually possible to complete the writing of a single last frame between EW and EOT. When this has been done or when EOT is found, all further write operations are discontinued even if the there are more data to be written in the data buffer.

2.3. Partitions Within a Volume

A volume may be split into several mini-volumes called partitions. Each partition has its own set of beginning and ending points. Each partition within a volume has defined its own *Beginning-Of-Partition* (BOP), Recording-Area, Early-Warning-Area and *End-Of-Partition* (EOP).

In the first partition (partition zero) on a volume with *n* partitions, BOP is identical to BOM. In the last partition on a volume (partition *n-1*), EOP is identical to EOM.

All volumes have a minimum of one partition called partition zero, or the *default partition*.

When a volume is mounted (that is inserted into the Drive and then loaded), the volume is logically positioned to the beginning of the default partition (partition zero). This is also true when a LOAD command (with the Load bit set to one) is executed. When a REWIND or ERASE command is received in any partition, the Drive positions to the beginning of the current partition.

2.3.1. Partitioning a Volume

Setting up a Medium Partition page and then executing a MODE SELECT command transferring this page to the Drive can partition a volume. The table below shows the parts of the Medium Partition Page(1) that relate to this procedure. Fields of no interest are marked with “XX...XX”.

BYTE	BIT 7	6	5	4	3	2	1	0
00	**PS**	XX	Page Code = 11h					
01	Parameter Length = 4Eh							
02	**Maximum Additional Partitions**							
03	**Additional Partitions Defined**							
04	**FDP**	**SDP**	**IDP**	**PSUM**		XX	XX	XX
05	XXXX							
06	XXXX				**Partition Units**			
07	XXXX							
08 09	**Partition Size Descriptor 0**							
| |	. . .							
78 79	**Partition Size Descriptor 35**							

Table 2-1: The Medium Partition Page(1)

Note that the Tandberg SLR Product Line Tape Drives use the *long form* of the Medium Partition Page(1). This means that the Partition Size Descriptor fields are always present (both in MODE SELECT and MODE SENSE parameter data).

Note also that the Medium Partition Page(1) is *not* savable (the MODE SENSE command returns a Medium Partition Page(1) where the PS bit is set to zero).

Partitioning a volume is only allowed when the volume is positioned at BOM (the beginning of partition 0). Note also that a partition operation may lead to a loss of all existing data (the Drive runs an erase pass in each of the existing partitions if the new partitioning is different from the existing partitioning found on the medium).

The Tandberg SLR Product Line Tape Drives allow the Initiator to specify partitioning using two different methods. The first is the most general. The Initiator can specify both the number of partitions and their individual sizes. Using the second method the Initiator may only specify whether one or two partitions are requested. When a single partition is requested it will cover the whole medium. When two partitions are requested the Drive will allocate them fixed sizes (there will be one large and one small partition).

The Initiator Defined Partitions (IDP) bit is used to select between the two methods. When the IDP bit is one, the first method is used (the number and size of partitions may be specified).

When the IDP bit is zero, the second method is used. In this case the FDP bit is used to select one or two fixed size partitions. This method of using partitions is often called “ Quick File Access” (QFA).

Regardless of which method is used, executing a MODE SELECT command where the Medium Partition Page(1) is included in the parameter list, some form of partitioning will take place. This means that such a MODE SELECT command is only accepted at the beginning of partition 0 (BOP0).

The Partition Size Unit of Measure (PSUM) field defines the unit of the Partition Size Descriptors. A value of 2 specifies the unit to be MBytes and a value of 3 specifies the unit to be GBytes. MODE SELECT will ignore this field when the IDP bit is not set. MODE SENSE will return 2 (MBytes) in this field when the currently mounted volume has a capacity (uncompressed) of 65535 MBytes or less. MODE SENSE will return 3 (GBbytes) in this field when the capacity is above 65535 MBytes. This boundary is introduced because 65535 (FFFFh) is the maximum value of the Partition Size Descriptors.

The Partition Units field defines the unit of the Partition Size Descriptors when the PSUM field is set to 3. The Partition Units must be set to 9 when the PSUM field is set to 3 to indicate that GBytes (10^9) is the only supported unit.

The Maximum Additional Partitions field is ignored by the MODE SELECT command. When the Medium Partition Page(1) is returned by the MODE SENSE command this field is used to indicate the maximum number of partitions (in addition to the default partition) that the current medium is able to hold.

The Additional Partitions Defined field is used to specify the requested number of partitions (MODE SELECT) or it shows the actual number of partitions (MODE SENSE). The Partitions Size Descriptors is used to specify the requested size of each partition (MODE SELECT) or to show the current (estimated) size of each partition (MODE SENSE).

Note that setting the IDP or FDP bits to one is only allowed when the medium to be partitioned is a SLRtape140 to SLRtape7 or SLR32, medium. In this case a maximum of 24 partitions is allowed when using a SLRtape140, SLRtape100, SLRtape75, SLRtape60 or SLRtape40 medium. A maximum of 36 partitions is allowed when using a SLRtape50, SLR32 or SLRtape24 medium. A maximum of 3 partitions is allowed when using a SLRtape7 medium. (See also section 2.3.3 Using Initiator Defined Partitions).

When using other medium types, partitioning can not be used and only a single partition is available.

When partition sizes are quoted later on in this section, all sizes are uncompressed sizes.

2.3.2. Selecting a Partition

Two commands makes it possible to select a partition for read or write operations; the LOCATE command and the MODE SELECT command.

2.3.2.1. Selecting a Partition Using LOCATE

The LOCATE command can be used to specify the active partition. The Change Partition (CP) must be set to one and the Partition field must be set to the desired partition. The addressed partition must exist on the volume mounted. The Drive will then move to the specified partition before the actual block locate operation starts.

The READ POSITION and MODE SENSE commands may be used to read the current partition number in use.

When the partition has been changed, the Drive will stay in the selected partition for all media access commands until one of the following actions are taken (by the Initiator):

- *A new LOCATE with CP set to one is executed.*
- *A MODE SELECT command is executed that changes the state of the Active Partition field in the Device Configuration Parameters Page (page code 10h).*
- *A LOAD command is executed. This command always brings the tape to the beginning of the default partition (partition 0).*
- *The cartridge is removed from the Drive. A newly inserted cartridge must be loaded before it can be accessed. The load operation positions the tape at the beginning of the default partition (partition 0). This will be true whether the load operation happens as a result of an Auto Load or an explicit LOAD command (with the Load bit set to one).*

2.3.2.2. Selecting a Partition Using MODE SELECT

The MODE SELECT command can be used to specify the active partition. The Device Configuration Parameters Page (page code 10h) is used for this purpose. The Change Active Partition (CAP) bit must be set to one and the Active Partition field must be set to the desired partition. The addressed partition must exist on the volume mounted. The Drive will then position the tape at the *beginning* of the specified partition.

The READ POSITION and MODE SENSE commands may be used to read the current partition number in use.

When the partition has been changed, the Drive will stay in the selected partition for all media access commands until one of the following actions are taken (by the Initiator):

- *A new MODE SELECT command is executed that changes the state of the Active Partition field.*

- *A LOCATE with CP set to one is executed.*

- *A LOAD command is executed. This command always brings the tape to the beginning of the default partition (partition 0).*

- *The cartridge is removed from the Drive. A newly inserted cartridge must be loaded before it can be accessed. The load operation positions the tape at the beginning of the default partition (partition 0). This will be true whether the load operation happens as a result of an Auto Load or an explicit LOAD command (with the Load bit set to one).*

2.3.3. Using Initiator Defined Partitions

When using a SLRtape140 to SLRtape7 or SLR32, medium the Initiator may specify both the number and the size of partitions (the IDP bit is set to one).

The following table shows the minimum number of tracks and track sets that can be allocated to a partition for each medium type. It also shows the maximum number of partitions and the minimum partition size.

Medium Type	Min. Track Sets	Min. Tracks	Max. Partitions	Min. Partition Size
SLRtape140	2	8	24	2916 MBytes
SLRtape100	2	8	24	2083 MBytes
SLRtape75	2	8	24	1563 MBytes
SLRtape60	2	8	24	1250 Mbytes
SLRtape50	2	4	36	694 Mbytes
SLRtape40	2	8	24	833 MBytes
SLRtape7	12	24	3	6666 Mbytes
SLR32	2	4	36	444 Mbytes
SLRtape24	2	4	36	333 Mbytes

Table 2-2: Minimum Partition Size

All partitions start at the BOT side of the medium. This means that the Drive will be able to access any partition with a minimum of tape movements after an auto-load or a LOAD command.

Here is a simple example using an SLR32 medium. The volume has been partitioned into 3 partitions (one default partition and 2 additional partitions):

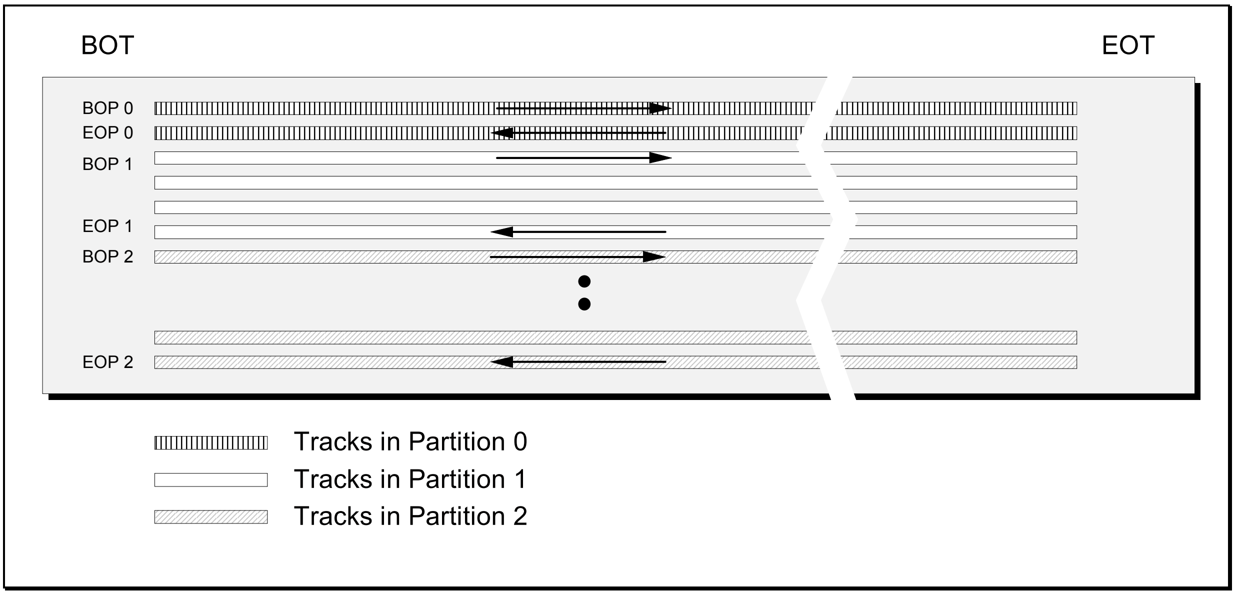


Figure 2-3: Multiple Partition Track Layout (SLR32 example)

The default partition (partition 0) has been allocated 2 track sets, partition 1 has been allocated 4 track sets while the last partition, which is partition 2 in this case, has been allocated the remainder of the medium (66 track sets).

When the IDP bit in the Medium Partition Page(1) is set to zero, the Drive allocates one or two fixed sized partitions on the volume mounted. See section *2.3.4. Quick File Access (All Formats)* for information on how to use this method.

When the IDP bit is set to one, the Additional Partitions Defined field is used to specify the number of partitions requested. Note that this field specifies the number of partitions requested *in addition* to the default partition. If a total of 10 partitions are requested, the Additional Partitions Defined must be set to 9. The Partition Size Descriptors are used to specify the individual sizes of the requested partitions. Note that the size of the default partition (partition 0) must be included among the Partition Size Descriptors.

Since there is no provision in a Partition Size Descriptor to identify the number of a partition, the number of a partition is the relative position of the Partition Size Descriptor in the Medium Partition Page(1). The size of partition 0 is specified in the first Partition Size Descriptor, that is in bytes 8 and 9. Partition 1 is specified in bytes 10 and 11, etc.

When the Medium Partition Page(1) is used to specify the size of any partition, the Partition Size Descriptor fields are used to specify a requested size. As the actual partition size must match an integral number of track set pairs, the Drive will round the value requested up to the nearest number divisible by the minimum partition size given by the loaded medium (see table 2-2). As an example, if a partition is requested to have a value of 450 MBytes, the Drive will round the size up to 666 MBytes (333 * 2) when using an SLRtape24 medium, up to 694 MBytes when using an SLRtape50 medium and up to 2916 MBytes when using an SLRtape140 medium. If a partition is requested to have a size of 200 MBytes, the Drive will round the size up to 333, 444, 694 or 2916 Mbytes and so on. The Partition Size Descriptors returned by the MODE SENSE command may be used to read out the partition sizes after rounding has taken place.

The number of Partition Size Descriptors must always equal the Maximum Addition Partition plus one, specifying the size of the default partition plus all additional partitions. When the Additional Partitions Defined is less than the Maximum Additional Partitions, the last Partition Size Descriptors are set to zero. If the Maximum Additional Partitions field has a value of 35 and the Additional Partitions Defined has a value of *n*, then there must be *n+1* non-zero Partition Size Descriptors. These descriptors must be the **first** *n+1* descriptors (the medium has been partitioned into *n+1* partitions numbered 0 through *n*). The last *35-n* Partition Size Descriptors are all set to zero. The size of partition 0 (the default partition) must be greater than zero.

The sum of all sizes requested by the non-zero Partition Size Descriptors may be less than the total size on the medium. In this case some capacity remains inaccessible.

Sometimes it may be desirable to have the last partition cover the remainder of the medium. In this case the last non-zero Partition Size Descriptor can be set to a value of FFFFh.

If insufficient space exists on the medium for the requested partition sizes or if multiple Partition Size Descriptors are set to FFFFh, the Drive will return CHECK CONDITION status.

When medium information has been read by the Drive, the Medium Partition Page(1) returned by a MODE SENSE command indicates the actual partitioning on the currently mounted volume (the number and size of each partition). When medium information has not yet been read by the Drive, the Additional Partitions Defined and the Partition Size Descriptor fields are undefined and set to zeros. The SLR5 and DC9250 media have limited medium information and the Additional Partitions Defined and the Partition Size Descriptor fields are always undefined and set to zeros for these media.

Note however that the partitions sizes returned by a MODE SENSE command are *estimated* sizes. The sizes are based on the calculated capacity for a given number of pairs of track sets. The actual size achieved may differ from the estimated size due to such factors as tape length variations, the number of re-writes and amount of filler data written by the Drive.

2.3.4. Quick File Access

Partitions can be used to support the implementation of QFA (Quick File Access). QFA is a feature which provides support for two partitions on a volume, a *directory partition* and a *data partition*. When using QFA the initiator is not allowed to specify the size of those partitions. Only the number of partitions (one or two) can be specified.

The QFA mode can be enabled and disabled with the FDP bit of the Medium Partition Page(1). When *not* in QFA mode the Drive will implement a single partition covering the whole tape. This single partition is called the Default Data Partition.

Note that QFA is only supported when the medium to be partitioned is a SLRtape140 to SLRtape7 or SLR32 medium.

Partition	Use
0	Data
1	Directory Information

Table 2-3: Partitions Within A QFA Volume

In QIC compatible tape streamers like the Tandberg SLR Product Line Tape Drives, all partitions start on track set boundaries at the physical BOT end of the tape. Two track sets (a total of 4 tracks) are allocated to the directory partition when using the SLR6, QIC-5010-DC, MLR3 or ALRF-2 tape formats. For the ALRF-1 and ALRF-6 tape format two track sets (a total of 8 tracks) are allocated. All remaining track sets are allocated to the data partition.

The following table shows the directory track set allocation for all supported tape formats:

Medium Type	Approximate Size	Directory Track (Set) Number
SLRtape140	2916 MBytes	46 and 47
SLRtape100	2083 MBytes	46 and 47
SLRtape75	1563 MBytes	46 and 47
SLRtape60	1250 MBytes	46 and 47
SLRtape50	694 MBytes	70 and 71
SLRtape40	833 MBytes	46 and 47
SLRtape7	1111 MBytes	34 and 35
SLR32	444 MBytes	70 and 71
SLRtape24	333 MBytes	70 and 71

Table 2-4: Directory Track set Allocation

When the medium has been identified the Medium Partition Page(1) returned by a MODE SENSE command may indicate the actual partitioning on the currently mounted volume (the number and size of each partition). When the medium has not been identified the Additional Partitions Defined and the Partition Size Descriptor fields are undefined.

Note that the partition size(s) returned by a MODE SENSE command are *estimated* sizes. The sizes are based on the calculated capacity for a given number of tracks. The actual size achieved may differ from the estimated size due to such factors as tape length variations, the

number of re-writes and amount of filler data written by the Drive.

2.3.4.1. Setting QFA-Mode

The MODE SELECT command is used to enter or leave the QFA mode.

The Drive will be in non-QFA mode when the FDP bit in the Medium Partition Parameter Page (Page Code 11h) is set to zero. The Drive will be in QFA mode when the FDP bit is set to one.

When going into QFA mode the FDP bit must be set to one (the IDP bit must be set to zero). The Page Length field must be set to 4Eh (to keep the page at a non-changing length). The Maximum Additional Partitions field is ignored. The Additional Partitions Defined field is ignored (the Drive always partition the volume into two partitions when FDP set to one). The SDP and the IDP bits must be set to zero. The PSUM and Partition Units fields are ignored. The CLEAR and ADDP bits must be set to zero. The Medium Format Recognition field must be set to 01h (the value returned by the MODE SENSE command). The Partition Units field must be set to zero. The Partition Size Descriptor fields are ignored by the drive (they can have any value).

When leaving QFA mode (when partitioning the volume into a single partition) all fields have the values given above. The only exception is that the FDP bit is set to zero.

Setting or clearing the FDP bit is only legal when the tape is positioned at BOT. Note also that a change in partitioning (going from 1 to 2 partitions or the other way around) leads to loss of all existing data (the Drive runs an erase pass in each of the existing partitions).

Since the Medium Partition Page(1) is not savable, the Initiator is responsible for making sure that the correct QFA mode is active whenever a new cartridge is loaded.

When a QFA mode corresponding to the currently loaded volume is in effect, the Medium Partition Page(1) returned by the MODE SENSE command will indicate both the number of partitions in effect and the size of those partitions. In non-QFA mode the Additional Partitions Defined field returns 00h (indicating a single partition). The very first Partition Size Descriptor field returns the approximate size of the default (and only) partition. In QFA mode the Additional Partitions Defined field returns 01h (indicating a total of two partitions). The first Partition Size Descriptor field returns the approximate size of the data partition while the second Partition Size Descriptor field indicates the approximate size of the directory partition.

2.3.4.2. Changing Partition Using The LOCATE Command

The LOCATE command can be used to specify the active partition. The Change Partition (CP) must be set to one and the Partition field must be set to 0 (Data Partition) or 1 (Directory Partition). The Drive will then move to the specified partition before the actual block locate operation starts.

2.3.4.3. Changing Partition Using the MODE SELECT Command

The MODE SELECT command can be used to specify the active partition. The Device Configuration Parameters Page (page code 10h) is used for this purpose. The Change Active Partition (CAP) bit must be set to one and the Active Partition field must be set to 0 (Data Partition) or 1 (Directory Partition). The Drive will then position the tape at the beginning of the specified partition.

2.4. Logical Elements Within a Partition

The Recording-Area on a volume may contain two types of Initiator accessible elements; *data blocks* and *tape marks*. These elements are controlled and transferred between the Initiator and the medium using READ, WRITE and WRITE FILEMARKS commands.

A unit of data supplied or requested by the Initiator is called *a logical block*. Logical blocks are stored according to the specifications of the tape format used (see [9] - [14]) and may be recorded as one or more physical blocks on the medium. When the physical block and the logical block are not recorded in a one-to-one relationship, it is the responsibility of the device to perform all blocking, de-blocking or padding of the logical block(s) sent to/from the Initiator.

Filemarks are one kind of tape marks. Filemarks are special recorded elements containing no user data. Initiators traditionally use filemarks to separate user data from labels and logical groupings of data from each other.

Setmarks are another kind of tape marks. Setmarks are special recorded elements containing no user data, providing a segmentation scheme hierarchically superior to filemarks.

Interblock gaps, the gaps between blocks and tapemarks, are introduced on the medium at the time a block or tapemark is written without explicit action by the Initiator. Minimum and maximum lengths for interblock gaps are defined in [9] - [14].

In addition to blocks, tape marks and inter-block gaps, *erase gaps* can be recorded. An erase gap is automatically recorded when a write operation is properly terminated. The erase gap acts as an end-of-data marker on some tape formats.

In addition a single erase gap may be recorded on the medium through the use of the ERASE command. This erase gap will cover the whole - or a limited part - of the medium and the pre-recorded information in the erase gap will be written over and lost. Refer to section 8 for further details about the ERASE command.

After writing data from BOP on a partition, the medium is considered to be a contiguous grouping of blocks, filemarks, setmarks and gaps. Certain ANSI standards define gap lengths which, if exceeded, are to be considered as having reached blank medium. Depending on the tape format, this blank medium may be treated as an end-of-data indication or an unrecoverable medium error causing an interchange error. Unrecorded volumes (new or erased) may exhibit blank medium characteristics if an attempt is made to read or space the volume before data have been written.

2.5. Overwrite

Normally tape streamers do not allow update of data already written on a volume. The structure and layout of the physical elements on the Recording-Area are such that they do not facilitate writing over old data with new data in the middle of a partition. When writing new data on a volume there are only two possibilities:

- A write operation may be started from BOP. All existing data on that partition will be destroyed. This is true even if the new write operation writes less data than the amount of data already on the partition. The data " left" on the partition can not be recovered.
- A write operation may *append* data to existing data on a partition. In this case the medium must be positioned at end-of-data (EOD) before the write operation is started. The medium may be positioned at EOD by reading or spacing until the Drive indicates EOD. It is also possible to position the medium to EOD by executing a SPACE command with a Space Code of 3 (Space to EOD).

If the current tape position is not at BOP or EOD, a write operation will be terminated immediately with CHECK CONDITION status and the Error Code is set to WRITE APPEND ERROR (Write After Read).

However, in addition to the two possibilities mentioned above, the Tandberg SLR Product Line Tape Drives offer under certain conditions the following two overwrite capabilities:

- The data following the very first data block in a partition may be written over (leaving the first data block intact). The following restrictions do however apply:

  1) The medium must be positioned after the 1st logical block in partition 0.

  2) The length of this block must be less than 65536 (10000h) bytes when using a SLRtape140 to SLRtape7 or SLR32, medium or less than 32768 (8000h) bytes when using an SLR5 or DC9250 medium.

  3) There must be no tapemarks either immediately in front of or immediately after the 1st data block.

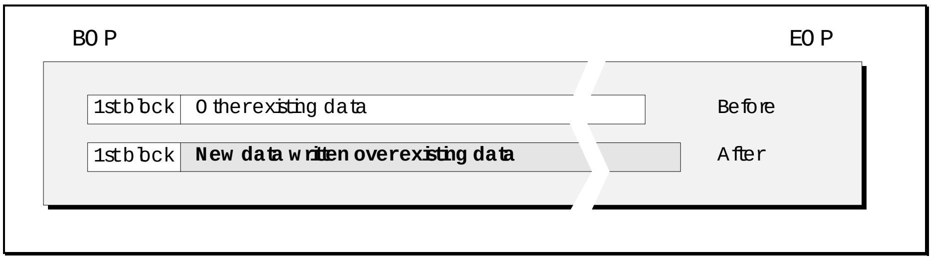


Figure 2-4: Overwrite After the 1st Logical Data Block

- The last filemark in a partition may be written over. The following restrictions do however apply:

  1) The filemark must be the last of two sequential filemarks.

  2) EOD must follow immediately after the filemark to be written over (no data must follow the two filemarks).

  3) The medium must be positioned in front of the filemark to be written over.

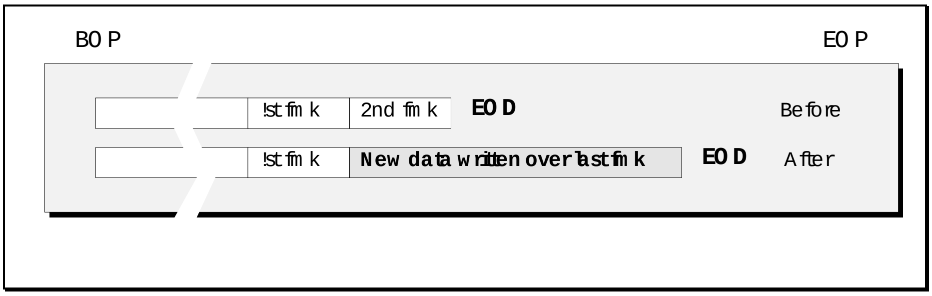


Figure 2-5: Overwrite of Last Filemark

The overwrite capability is a configurable feature. It is controlled by the EOWR bit in the Miscellaneous Parameters Page of the MODE SELECT command.

2.6. Using Fixed and Variable Length Blocks

2.6.1. Variable and Fixed Length Blocks

The Drive is capable of supporting both fixed and variable length logical blocks. The concept of fixed or variable mode for writing and reading blocks only indicates the method by which the Initiator specifies the size of the logical block for transfer and not the method of recording physical blocks on the medium.

When writing the Drive transforms logical blocks passed from the Initiator into physical blocks to be stored on the tape. The length of a logical block may vary while the length of a physical block is defined by the tape format in use (see [9] - [14]). When reading the Drive transforms physical blocks from the tape back into logical blocks to be transferred to the Initiator,

When executing read and write commands two parameters must be specified; the block length and the number of blocks to read or write. As the SCSI read and write commands only have room for a single parameter, only the block length *or* the number of blocks can be specified directly. For this reason there are two different versions of each command capable of transferring tape data to or from the Initiator. The fixed length type commands can specify the *number* of blocks to be processed. For these commands all blocks will be of equal size. The actual size is given by the current value in the Block Size field in the Block Descriptor List of the MODE SELECT command. The variable length type commands can specify the *length* of the individual blocks, but the number of blocks written is always only one (for each command).

When the Block Size field has a value different from zero, the Drive is said to be in *fixed block mode.* In this mode both the fixed length type commands and the variable length type commands are allowed. When the Block Size field is zero, the Drive is said to be in *variable block mode*. In this mode only the variable length type commands are allowed (as writing fixed length blocks of size zero bytes does not make any sense).

Note that the illegal length handling in the READ command differs slightly depending on the current fixed/variable mode set by the MODE SELECT command.

2.6.2. Writing

When writing, the Drive groups the data transferred from the Initiator into blocks. Data blocks may be written with two different versions of the WRITE command; one with the fixed (FIX) bit set and one with the fixed (FIX) bit cleared.

When the FIX bit is cleared, a WRITE command will write a single block. The block length may be specified on a block-by-block basis. This is useful when writing blocks of varying length.

When the FIX bit is set to one, a WRITE command may write multiple blocks. The WRITE command must specify the number of blocks to write. All written blocks will be of the same length. The block size is controlled by the Block Size field in the MODE SELECT Block Descriptor List. Depending on the tape format used, different fixed block sizes are supported.

Note that when the Block Size field has been set to zero, the Drive is said to be in Variable Block mode and commands with the FIX bit set to one are not allowed.

2.6.3. Reading

When reading data off a tape, the Drive is able to determine the length of each block read. When reading, the expected block length must be specified. This can be done in two different ways with the two different versions of the READ command; one with the fixed (FIX) bit set and one with the fixed (FIX) bit clear.

When the FIX bit is clear, a READ command will read a single block. The expected block length may be specified on a block-by-block basis.

When the FIX bit is set to one, a READ command may read multiple blocks. The READ command must specify the number of blocks to read. The expected block length of all blocks is the same. The expected length is specified with the MODE SELECT command (the Block Size field of the Block Descriptor List). Note that when the Block Size field has been set to zero, the Drive is said to be in Variable Block mode and commands with the FIX bit set to one are not allowed.

2.6.4. Illegal Length Conditions when Reading

When the specified block length does not match the actual block length, the READ command will complain (if the Suppress Illegal Length Indicator (SILI) bit was not set in the READ Command Descriptor Block).

If the actual block length is smaller then the expected block length, the READ command will transfer the actual number of bytes found in the block. The READ command is then terminated with a CHECK CONDITION Status. The Illegal Length Indicator will be set in the Sense Data List. If the fixed-bit is cleared, the Information Bytes will be set to the difference between the expected number of bytes and the actual number of bytes. This will be a positive number in this case. If the fixed-bit is set, the Information Bytes will be set to the difference between the specified number of blocks and the actual number of blocks transferred. The block with the unexpected length is counted among the transferred blocks even if its length was wrong. Note that this means that the Information Bytes may read zero even if the READ command was terminated with CHECK CONDITION and Illegal Length Indication. The logical tape position will be at the beginning of the next block on the tape.

If the actual block length is larger than the expected block length, the READ command will transfer the expected number of bytes only. The READ command is then terminated with a CHECK CONDITION Status. The Illegal Length Indicator will be set in the Sense Data List. If the fixed-bit is cleared, the Information bytes will be set up with the difference between the expected number of bytes and the actual number of bytes. This will be a negative number in this case. The information bytes are presented as a 32 bit 2's complement number. If the fixed-bit is set, the Information bytes will be set up with the difference between the specified number of blocks and the actual number of blocks transferred. The block with the unexpected length is counted among the transferred blocks even if its length was wrong. Note that this means that the Information Bytes may read zero even if the READ command was terminated with CHECK CONDITION and Illegal Length Indication. The logical tape position will be at the beginning of the block following the block with the unexpected length. This means that the additional bytes in the block with the unexpected length are lost.

2.7. Data Buffering

2.7.1. Introduction

The Drive has a temporary storage area capable of holding one or more blocks or tapemarks – a data buffer. The data buffer may hold any combination of data blocks and tapemarks in the process of being written to the recording medium, or it may contain read-ahead data blocks and tapemarks transferred from the recording medium.

The data buffer operates as a FIFO queue, compensating for the different transfer rates on the SCSI-bus and the tape system. The Drive is usually only connected to the SCSI-bus for short amounts of time when bursts of data are transferred at a much higher speed than the normal tape transfer rate. The data buffer can be in one out of two modes; read mode or write mode. The data buffer is in write mode when executing WRITE or WRITE FILEMARKS commands. The data buffer is in read mode when executing LOCATE, READ, SPACE or VERIFY[1] commands.

[1] VERIFY is not supported by SLR7 and SLR140

2.7.1.1. SLR50 Drive

The data buffer in the SLR50 Drive has been split into two distinct partitions, a *host buffer* and a *tape buffer*.

Host Buffer

The host buffer is used to buffer logical blocks transferred at high-speed (up to 20 MBytes/s) to/from the SCSI interface. Notice that only *data* are buffered in the host buffers. Tapemarks do not occupy any space in the host buffer. Tapemarks do however consume other resources in the buffers system so there is an upper limit to the number of tapemarks that the buffer system is able to hold.

Tape Buffer

The tape buffer is used to buffer formatted physical blocks going to/from the recording medium. The data in the tape buffer is transferred to/from the media at speeds varying from up to 2 MBytes/s (SLRtape50 medium) down to 480 KBytes/s (DC9250 medium).

A *data formatting unit* sits in the data path between the host buffer and the tape buffer. An optional *data compression unit* may also be placed in the data path between the two buffers.

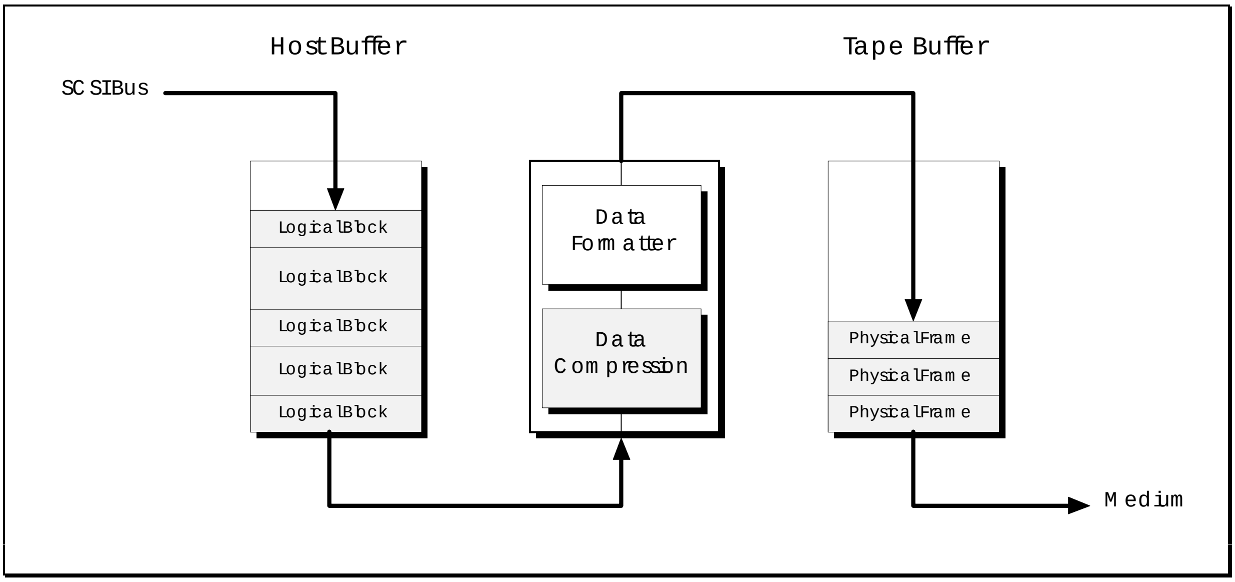


Figure 2-6: The SLR50 Buffer System (Write Mode)

In a SLR50 Drive equipped with a 1 MByte physical data buffer the host buffer will occupy about 450 KBytes while the tape buffer is allocated 512 KBytes. For drives equipped with a 2 MByte physical data buffer the host buffer will occupy about 1450 KBytes while the tape buffer is allocated 512 KBytes.

Note that the use of the host buffer is optimized so that as long as most logical blocks are of the same size the complete allocated size for the host buffer is utilized to buffer data. When mixing blocks of different sizes or when a very large number of tapemarks are flowing through the buffer system, the effective host buffer size may be somewhat less than the allocated size.

2.7.1.2. SLR7, SLR60, SLR75, SLR100 and SLR140 Drives

The data buffer in the SLR7, SLR60, SLR75, SLR100 and SLR140 Drives consists of a single logical unit with a size of nearly 8 MByte.

Data Buffer

The data buffer is used to buffer data from logical blocks transferred at high-speed (up to 40 MBytes/s) to/from the SCSI interface. When moved into the buffer the data is first compressed and then formatted into frames of physical blocks. The data in the data buffer is then transferred to/from the media at speeds varying from up to 6 MBytes/s (SLR140) down to 3 Mbytes/s (SLR7).

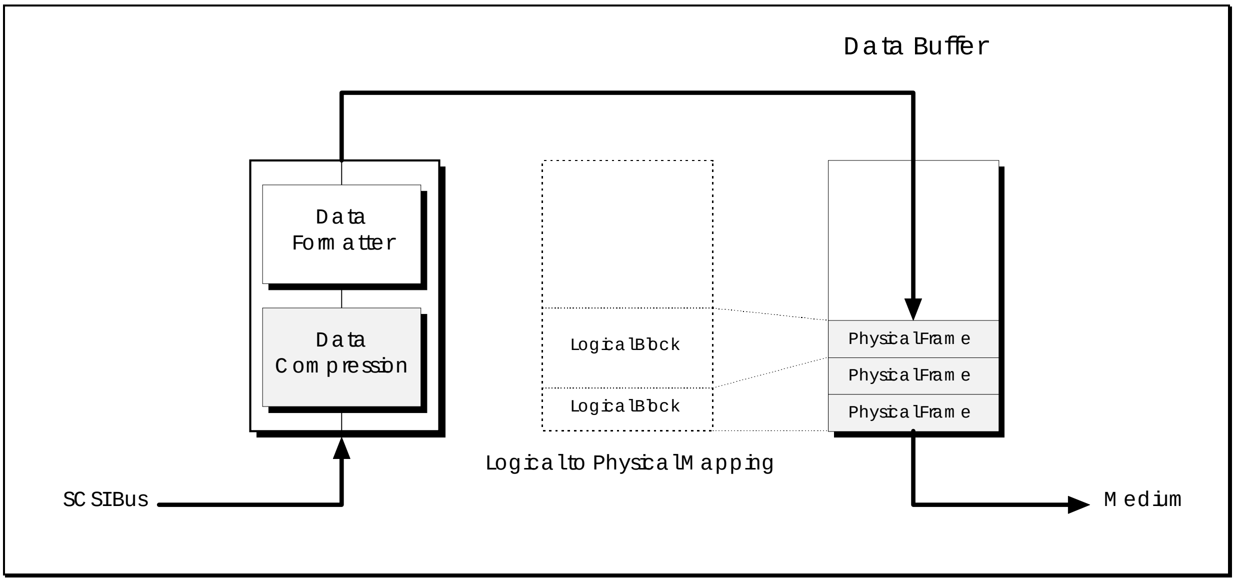


Figure 2-7: The SLR140, SLR100, SLR75, SLR60 and SLR7 Buffer System (Write Mode)

Note that the use of the buffer is optimized so that as long as most logical blocks are of the same size the complete allocated size for the host buffer is utilized to buffer data. When mixing blocks of different sizes or when a very large number of tapemarks are flowing through the buffer system, the effective buffer size may be somewhat less than the physical size.

2.7.2. Data Formatting

When data are moved from the host buffer to the tape buffer it is grouped into *physical blocks*. The physical blocks are again grouped into *frames*. In addition to host related data and tapemarks the frames hold additional information like *error correction codes* (ECC) [9] - [17].

The size of the physical block as well as the number of blocks per frame depend on the tape format used [9] – [17].

The tape buffer is used to buffer complete frames. The maximum number of frames depends on the tape format in use. With an SLR32 medium for example, the tape buffer is able to hold up to 16 frames each holding a maximum

of 52 physical blocks of user data (each block is 512 bytes long). In addition each frame has 12 blocks of ECC information [13]. For other tape formats the values differs.

The size of a logical data block may be different than the size of a physical data block. In the tape buffer the size of a physical block is fixed (as given by the current tape format). In the host buffer the size of a logical block may vary since the Drive supports a wide range of fixed- and variable logical block sizes. The required blocking and de-blocking into logical blocks is handled by the data-formatting unit.

When the data compression option is not used, one logical block usually occupies at least one complete physical block. There is one exception. When writing 512 byte blocks with the FIXED bit set to one, a special option is used on SLR5 and DC9250 media allowing two logical blocks to share one physical block [9] - [10].

Large logical blocks may span several physical blocks.

When data compression is used, the number of physical blocks needed for each logical block depends on the compression ratio achieved.

2.7.3. Buffered Mode

The Drive is capable of operating in both a buffered mode and an unbuffered mode. Buffered mode is not applicable during read commands. When operating in buffered mode the Drive returns GOOD status for write operations when all data have been successfully transferred from the Initiator into the data buffer. When operating in unbuffered mode, GOOD status is not returned until all requested data or tapemarks are successfully recorded on the medium.

When issuing a buffered WRITE FILEMARKS command with the immediate bit set to one, GOOD status is returned as soon as the tapemark(s) has been moved into the data buffer. A WRITE FILEMARKS command with the immediate bit set to zero causes any buffered data blocks or tapemarks to be written to the medium. Upon successful completion of this process, which is called a *synchronize* operation, no data blocks or tapemarks remain in the data buffer. (Host may perform this synchronize operation without writing actual tapemarks by specifying zero in the number of tapemark field in the WRITE FILEMARK command).

Should an unrecoverable write error occur while in buffered mode, the Drive generates an error condition. The error is reported on the next applicable operation as a deferred error.

Note that when operating in buffered mode the Drive will pack physical blocks from one WRITE or WRITE FILEMARKS command together with physical blocks from the previous WRITE or WRITE FILEMARKS command into the same frame (when a frame based tape format is used). This is not true when operating in non-buffered mode. If a WRITE or WRITE FILEMARKS command does not transfer enough data (or tapemarks) to fill a complete frame, the rest of the frame is filled up with filler blocks. This may of course waste a lot of space on a tape. When reading a tape containing frames with filler blocks the Drive is able to remove the filler blocks without generating any discontinuities in the data stream on the SCSI-bus. Note, however, that even if filler blocks are inserted

and removed automatically by the Drive they will occupy buffer space both in read mode and write mode.

2.7.4. Read-Ahead

When operating in read mode the Drive always tries to fill up the buffer with read-ahead data. This means that when a read type command terminates the Drive continues to read data off the tape. The read-ahead only stops when the data buffer is full, if a non-read command is issued or if there is no more data to read. The read-ahead also stops when an uncorrectable block has been detected.

Read-ahead minimizes tape start and stops because when a read type command (including SPACE and VERIFY[1]) follows another read type command the wanted data may already be ready in the data buffer.

When an error has been detected by the tape system the Drive does not report the error until all data up to the point where the error occurred has been read out of the data buffer. This means that if an unrecovered read error has occurred this error is not reported until an Initiator requests the data block in error.

2.7.5. Underrun/Overrun

When the Drive is in write mode data is moved from the data buffer on to the tape. The tape write operation can only continue as long as there is any data left to write in the data buffer. If the buffer for any reason becomes empty the write operation must be stopped. This can happen if the Initiator is too slow transferring data or if the Drive is configured in non-buffered mode. When the tape is stopped in this way an *underrun condition* has occurred. Note, however, that the tape is not stopped immediately. The Drive is able to delay the stopping for some limited amount of time. This may be controlled by the Initiator by manipulating the Forced Streaming Count in the Miscellaneous Parameters Page (see the MODE SELECT command). When the data buffer later becomes non-empty the tape write operation can continue (see also the next section)

When the Drive is in read mode data is moved from the tape and into the data buffer. If the data buffer becomes full the tape read operation must be stopped immediately. This can happen if the Initiator is too slow transferring data or if the Initiator has stopped issuing READ, SPACE or VERIFY[1] commands (remember the tape read-ahead). When the tape is stopped in this way an *overrun condition* has occurred. When the data buffer later is emptied the tape read operation may continue (see also the next section).

The number of underrun/overrun conditions encountered may be reduced by utilizing the Automatic Velocity Control (AVC) and/or Forced Streaming. If the Automatic Velocity Control is enabled, the drive will select the speed which, based on the data transfer rate, will optimize streaming activity and minimize medium repositioning (only if more than one speed is available for the active tape format). If Forced Streaming is enabled, the drive will keep on rewriting old data a configurable number of times before going into an

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[1] VERIFY is not supported by SLR7 and SLR140

underrun condition. See *2.9. Optimizing Streaming Operation* and the sections on MODE SELECT and MODE SENSE commands for further details about Automatic Velocity Control, tape speeds and Forced Streaming.

2.7.6. Buffer Thresholds

Both the host buffer and the tape buffer act like large FIFOs. Data blocks and tapemarks (and for the tape buffer also control blocks, filler blocks and ECC blocks) are inserted in one end of the FIFO and the same data is later removed at the other end.

In write mode, when moving data into the host buffer, data is entered at a certain preferred amount at the time. If there is not enough free space in the host buffer for this amount, no logical data blocks are entered at all. The room required is called a *buffer threshold*. There must usually be at least room for an amount of data corresponding to the buffer threshold before new data are transferred in from the SCSI-bus. This will minimize the number of disconnects/reconnects. This buffer threshold is configurable.

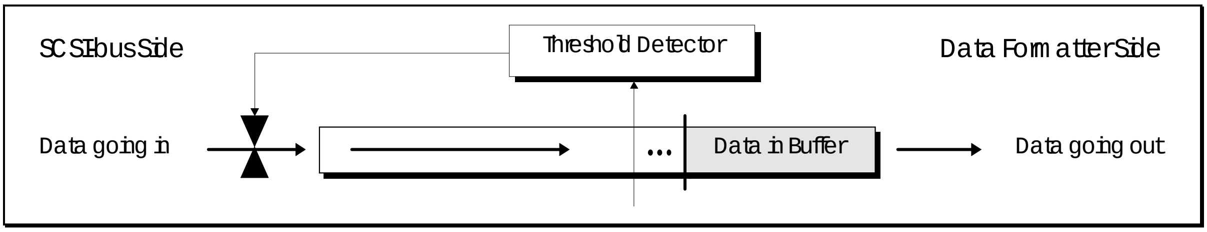

Figure 2-8: Host Buffer Data flow During Write Operations

When transferring data blocks out of the tape buffer and onto the tape a similar mechanism exists. When the FIFO for some reason is empty (an underrun condition), the tape write operation will not be started again until the number of blocks (data, control, filler, ECC or tapemarks) ready in the FIFO is equal to or larger than another buffer threshold. This will have a tendency to minimize the number of tape start and stops (underrun conditions). This threshold is fixed and is not under user control.

In read mode there are also two buffer thresholds; one controlling the tape read operation and one controlling the SCSI-bus transfer. These thresholds work in much the same way as the threshold in write mode. The host buffer threshold is configurable while the tape buffer threshold is fixed

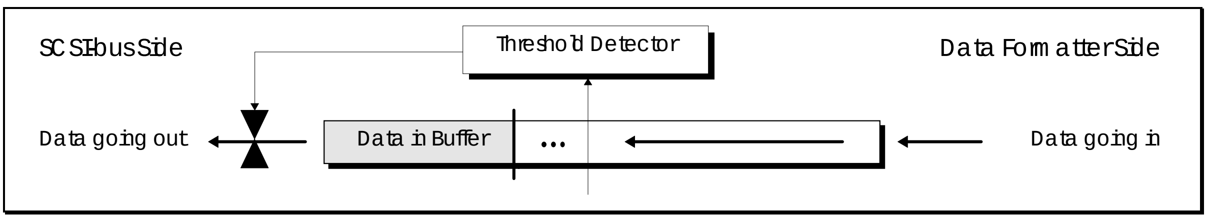

Figure 2-9: Host Buffer Data flow During Read Operations

Write Mode SCSI-bus Threshold

This is the threshold used when moving data from the SCSI-bus into the data buffer in write mode. This threshold is controlled by the *Write Buffer Empty Ratio*. The Write Buffer Empty Ratio may affect the disconnect/reconnect frequency on the SCSI-bus during DATA OUT phases. See the *Disconnect/Reconnect Page* of the MODE SELECT command for details.

Read Mode SCSI-bus Threshold

This is the threshold used when moving data from the data buffer to the SCSI-bus in read mode. This threshold is controlled by the *Read Buffer Full Ratio*. The Read Buffer Full Ratio may affect the disconnect/reconnect frequency on the SCSI-bus during DATA IN phases. See the *Disconnect/Reconnect Page* of the MODE SELECT command for details.

2.7.7. Disconnect/Re-connect

When the Drive is operating in write mode no data transfer will be initiated until the data buffer can accept the amount of data set up by the current write bus threshold. Instead the Drive disconnects from the SCSI-bus freeing the bus for use by other devices. As soon as the data buffer can accept the data, the Drive reconnects and transfers a burst of data. The size of the burst is upwards limited by either available buffer space or the Maximum Burst Size, whichever is smaller. The Maximum Burst Size is specified by the host by means of the Mode Select command. If still more data is requested for transfer, the Drive then disconnects again. A reconnect later will transfer another burst and the whole process repeats until all requested data have been transferred.

When the Drive is operating in read mode no data transfer will be initiated until the data buffer has ready the amount of data set up by the current read bus threshold. Instead the Drive disconnects waiting for enough data to become ready. When this happens the Drive reconnects and transfers a burst of data. The Drive will also reconnect if a tapemark is pending or if an exception has occurred. The size of the burst is limited by the Maximum Burst Size. If still more data is requested for transfer the Drive disconnects again. A reconnect later will transfer another burst and the whole process repeats until all requested data have been transferred.

2.7.8. Data Re-transfer

As a part of its bus parity error handling the Drive is able to re-transfer the last transferred burst any number of times.

When receiving data in write mode the Drive may optionally check for parity errors in the data received. When the complete data burst has been transferred the Drive changes from the data-out phase to the message-in phase. A RESTORE POINTERS message is then transferred to the Initiator. The Initiator should in response to this message reset its data pointer to where it was when the Drive instructed it to save its pointer the last time (with the SAVE DATA POINTER message sent each time the Drive disconnects) or if no such message has been received set the pointer back to where it was when the write type command was issued. The Drive then re-enters the data-out phase and transfers the last burst of data once more. The whole process can be repeated a number of times as long as the Drive detects parity errors in the received data.

When transferring data to the Initiator in read mode the Initiator may check for parity errors in the received data. When a parity error has been detected the Initiator may assert the ATN. After having transferred the complete data burst the Drive will honor the ATN condition by going from the data-in phase to the message-out phase. A message is then transferred from the Initiator. If this message is an INITIATOR DETECTED ERROR message the Drive will assume that the Initiator wants to have the last burst of data transferred once more. The Drive then goes to the message-in phase and transfers a RESTORE POINTERS message. The Initiator should then reset its data pointer to where it was when the Drive instructed it to save its pointer the last time (with the SAVE DATA POINTER message sent each time the Drive disconnects) or if no such message has been received set the pointer back to where it was when the read type command was issued. The Drive then re-enters the data-in phase and transfers the last burst of data once more. The whole process can be repeated a number of times as long as the Initiator asserts ATN during the data transfer.

See also the sub-section on *Bus Parity Error Handling* in section 7 for further information.

2.7.9. Buffer Parity Errors

The Drive is able to check for internal parity errors in its data buffer system. All data paths include a parity bit for every 8 bits of data. See the sub-section on *Buffer Parity Error Handling* in section 7 for details.

2.8. Data Compression

The Tandberg SLR Product Line Tape Drives support the Adaptive Lossless Data Compression (ALDC) algorithm. The ALDC is a variant of the LZ 1 (Lempel-Ziv 1) class of compression algorithms. For further details about the compression algorithm please refer to the description [8]. The actual compression and decompression are performed in hardware. For further details about the drive electronics, refer to the Tandberg SLR Product Line Reference Manual [1].

2.8.1. Background

Data compression can be used on all supported tape formats. When data compression is active, all data sent to the drive will be compressed (see section 2.8.2.2 for an exception). When compressed data is read the data is automatically decompressed. The Initiator may then issue a MODE SENSE command and check the Data Compression Parameter Page to investigate if the data on the tape is compressed or not.

When compression is enabled, the data will be compressed into groups of data called Compression Block Groups. Each of these groups will consist of an uncompressed Compression Header and compressed data. The data part is the result of compression of up to 64 KBytes (SLRtape24, SLR32 and SLRtape50 media) or 256 KBytes (SLRtape7, SLRtape40, SLRtape60, SLRtape75, SLRtape100 and SLRtape140 media) of original data [9] - [17].

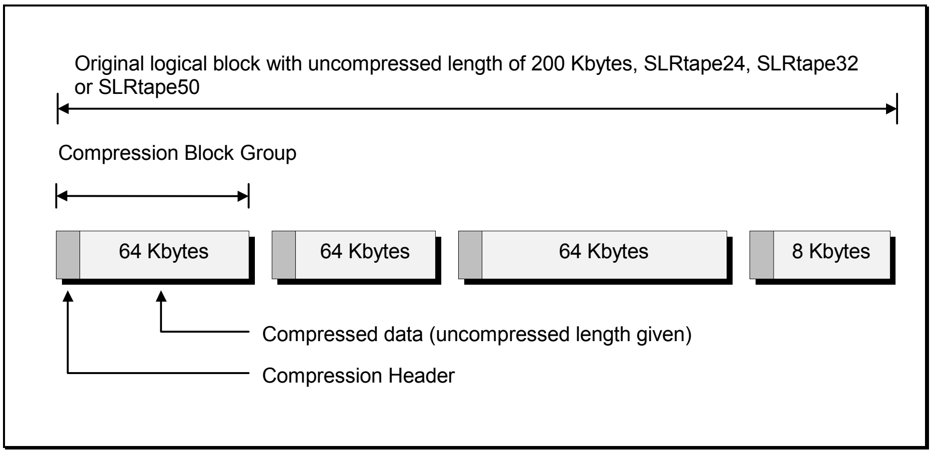

Figure 2-10: Packing Data in Compression Block Groups

The data compression ratio will depend on both the data pattern to compress and how the sequence of WRITE commands is issued to the Drive. Each start of a WRITE command with a block size different from the block size in the previous WRITE command will force a new Compression Block Group to be written, so a lot of WRITE commands transferring blocks of different sizes will result in a less than optimal compression ratio. Since the length of the Compression Header is 18 to 24 bytes large, the best performance is achieved by issuing WRITE commands writing large blocks or a large number of equal size blocks. Typical compression ratios are 2:1 to 3:1.

Note that in some cases data will actually expand when subjected to the compression process. This may for instance be the case when feeding already compressed data to the drive and the compression option is enabled.

When writing on a SLRtape50 media the drive will adaptively turn compression on and off. When a certain expansion has been detected the Drive decides that the data are not compressible and this piece of data will be written uncompressed. When data that is compressible again is presented to the drive (with a favorable compression ratio), compression is turned back on (if enabled at all).

When writing on SLRtape7, SLRtape40, SLRtape60, SLRtape75, SLRtape100 and SLRtape140 media the drive will keep compression on even if the data is not compressible. A worst case expansion of 12.5% may occur on certain data patterns.

When using SLRtape140 to SLRtape7 or SLR32, media any partition may hold a mix of compressed and uncompressed data.

When using an SLR5 or DC9250 medium the drive will not allow a mix of compressed and uncompressed data on the same medium. Before starting a write operation from BOM, compression may be turned on or off. At a later stage, it will not be possible to change the compression mode. When appending data on a tape, the drive will ensure that compression mode is preserved (on or off). This means that if the pre-written data on the medium is not compressed, the appended data will not be compressed (even if the DCE bit in the Data Compression Page has configured compression on). If, however, the pre-written data on the medium is compressed, the appended data will be compressed (even if compression has been configured off).

2.8.2. Controlling Data Compression

Data compression is controlled by fields in the Data Compression page of the MODE SENSE/SELECT page (page code 0Fh). This page is shown below. Fields of no interest are marked with “ XX” .

<table>
<tr><th>BYTE</th><th>BIT 7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th></tr>
<tr><td>00</td><td>XX</td><td>XX</td><td colspan="6">Page Code = 0Fh</td></tr>
<tr><td>01</td><td colspan="8">XX</td></tr>
<tr><td>02</td><td>DCE</td><td>DCC</td><td colspan="6">XX</td></tr>
<tr><td>03</td><td>DDE</td><td colspan="2">XX</td><td colspan="5">XX</td></tr>
<tr><td>04
|
07</td><td colspan="8">Compression Algorithm</td></tr>
<tr><td>08
|
11</td><td colspan="8">Decompression Algorithm</td></tr>
<tr><td>12</td><td colspan="8">XXXX</td></tr>
<tr><td>13</td><td colspan="8">XXXX</td></tr>
<tr><td>14</td><td colspan="8">XXXX</td></tr>
<tr><td>15</td><td colspan="8">XXXX</td></tr>
</table>

Table 2-5: Data Compression Page Descriptor

The usage of the different fields varies slightly as a function of the tape format used, but the following general description is true for all tape formats.

The DCC (Data Compression Capable) bit is a status bit that indicates whether a device has compression/decompression capabilities. The MLR Series Drives are always compression/decompression capable. When transferring a Data Compression page with a MODE SELECT command this bit must be set to one (it is not changeable). When a MODE SENSE command is used to retrieve the Data Compression page the value returned is always one.

The DCE (Data Compression Enable) is a configuration bit used to turn data compression on or off. Some restrictions apply when using SLR5 and DC9250 media. See below for further details. The MODE SELECT command is used to set/reset this bit. When a MODE SENSE command is used to retrieve the Data Compression page the value returned reflects the value set by the last MODE SELECT command.

The DDE (Data Decompression Enable) bit is used in two different ways depending on the tape format in use. See the following sub-sections for further details.

The Compression Algorithm field is a configuration field used to select a specific data compression algorithm to be used when data are being compressed. The SLR Series Drives support two values; A value of 3h selects the ALDC algorithm. A value of 0h means “no algorithm selected”. In this case the drive will not perform any data compression. This means that in order to have data compressed the DCE bit must be set to 1 and the Compression Algorithm field must be set to 3h. The MODE SELECT command is used to set a value in the Compression Algorithm field. When a MODE SENSE command is used to retrieve the Data Compression page the value returned in this field reflects the value set by the last MODE SELECT command.

The Decompression Algorithm field is a status field used by the drive to report which compression algorithm that was used when the data were written to a medium. The value in this field is valid only after this data have been read off the medium using a READ or VERIFY[1] command. A value of 3h indicates that the ALDC algorithm was used (the data on the medium is compressed). A value of 0h indicates that no algorithm was selected (the data on the medium is not compressed). A MODE SENSE command can be used to retrieve the Decompression Algorithm field. This field is ignored by the MODE SELECT command.

[1] VERIFY is not supported by SLR7 and SLR140

2.8.2.1. *Using SLRtape140, SLRtape100, SLRtape75, SLRtape60, SLRtape50, SLRtape40, SLRtape7, SLR32 or SLRtape24 Media*

When using SLRtape140 to SLRtape7 or SLR32 media it is possible to compress data on any partition. It is also possible to mix compressed and uncompressed data on the same partition. This means that the state of the DCE bit and the value of the Compression Algorithm field can be changed any time during write operations.

The DDE (Data Decompression Enable) bit is ignored when using these media. The Drive will, when transferring data to the Initiator, always decompress compressed data while uncompressed data are transferred without any decompression.

2.8.2.2. Using SLR5 or DC9250 Media

It is not possible to mix compressed and uncompressed data on a SLR5 or a DC9250 media.

None of the drives covered by this manual are able to write on these tapes. However, if the tapes are read, the drives will automatically enable data decompression if the tapes hold compressed data.

2.9. Optimizing Streaming Operation

For a tape streamer device underruns and overruns are typically time consuming. The stop, reposition and restart sequence may take a second or two. When this happens frequently, the average data transfer rate may suffer greatly.

In many cases using a combination of Automatic Velocity Control (AVC) and Forced Streaming can optimize streaming operation. AVC will automatically reduce tape speed if the transfer rate from host is weak or the compression ratio is high. Forced streaming will keep the drive streaming by writing dummy data while waiting for more data from host.

2.9.1. Forced Streaming

The Forced Streaming Count in the Mode Sense/Select - Miscellaneous Parameters Page is used to enable or disable the Forced Streaming mechanism in the drive. The parameter is designed to give the maximum number of times to rewrite the same block while waiting for more data from host. When the maximum number is reached the drive is entering underrun mode and tape will stop and do a backspace while waiting for more data from host. The Forced Streaming Count is by nature a write parameter only. But, note that if forced streaming blocks are written to the tape, the read speed will reduce accordingly since the tape has to pass dummy data while reading.

The Forced Streaming feature trades performance for capacity. The number of underruns can be reduced, but some capacity will be lost to the rewrite process.

Note however that if the host system is able to write data at twice the speed of the native rate of the current media and the data can be compressed 2:1 or more, you will always have at least 2:1 compression no matter how many forced streaming blocks written.

On SLR140, SLR100, SLR75, SLR60 and SLR7 drives the Forced Streaming setting is ignored. Due to a large data buffer and short underrun time, there is no reason to use Forced Streaming.

2.9.2. AVC (Automatic Velocity Control)

The AVC bit in the Mode Sense/Select - Device Configuration page is used to enable or disable the AVC mechanism in the drive. When an underrun (during write) or an overrun (during read) occurs, the tape will stop and do a backspace while waiting for more data to be written or read from host. In this underrun/overrun situation the AVC algorithm will try to predict if a speed reduction is optimal or not. If a speed reduction is chosen, the AVC algorithm will, while streaming, try to predict if it is optimal to increase the speed again. A speed increase will perform a forced underrun/overrun.

2.9.3. Using both Forced Streaming and AVC

Using a combination of Forced Streaming and AVC has the following advantages while writing:

- The AVC algorithm does have one more parameter to use when predicting optimal speed if the Forced Streaming is enabled (>0).
- The maximum " average" Forced Streaming used is reduced if the AVC algorithm is enabled. This results in a bit fewer forced streaming blocks written before underrun while at high speed, which results in less loss of capacity on the tape.

Note however that Forced Streaming and AVC are not available on all drives or medium types. For some drive and medium types one or both settings are ignored by the drive. See table 2-6 for details.

Drive	Medium	Forced Streaming	AVC
SLR140	SLRtape140	Ignored	**Available (2 speeds)**
	SLRtape100	Ignored	Ignored
	SLRtape75	Ignored	Ignored
	SLRtape60	Ignored	Ignored
	SLRtape50	Ignored	Ignored
	SLRtape40	Ignored	Ignored
	SLRtape7	Ignored	Ignored
SLR100	SLRtape100	Ignored	**Available (3 speeds)**
	SLRtape75	Ignored	**Available (3 speeds)**
	SLRtape60	Ignored	**Available (3 speeds)**
	SLRtape50	Ignored	Ignored
	SLRtape40	Ignored	**Available (3 speeds)**
	SLRtape7	Ignored	Ignored
	SLR32	Ignored	Ignored
	SLRtape24	Ignored	Ignored
SLR75	SLRtape75	Ignored	**Available (2 speeds)**
	SLRtape60	Ignored	**Available (2 speeds)**
	SLRtape50	Ignored	Ignored
	SLRtape40	Ignored	**Available (2 speeds)**
	SLRtape7	Ignored	Ignored
	SLR32	Ignored	Ignored
	SLRtape24	Ignored	Ignored
	SLR5	Ignored	Ignored
	DC9250	Ignored	Ignored
SLR60	SLRtape75	Ignored	**Available (2 speeds)**
	SLRtape60	Ignored	**Available (2 speeds)**
	SLRtape50	Ignored	Ignored
	SLRtape40	Ignored	**Available (2 speeds)**
	SLRtape7	Ignored	Ignored
	SLR32	Ignored	Ignored
	SLRtape24	Ignored	Ignored
	SLR5	Ignored	Ignored
	DC9250	Ignored	Ignored

Table 2-6: Forced Streaming and AVC On Different Medium Types (to be continued…)

Drive	Medium	Forced Streaming	AVC
SLR50	SLRtape50	**Available**	**Available (2 speeds)**
	SLR32	**Available**	**Available (2 speeds)**
	SLRtape24	**Available**	**Available (2 speeds)**
	SLR5	Ignored	Ignored
	DC9250	Ignored	Ignored
SLR7	SLRtape7	Ignored	Ignored
	SLR5	Ignored	Ignored

Table 2-6: Forced Streaming and AVC On Different Medium Types

2.9.4. Recommended Settings

SLR140, SLR100, SLR75, SLR60 and SLR7 Drives

- Forced Streaming = 0
- AVC = on

SLR50 Drives

- Forced Streaming = 1024
- AVC = on

The optimal Forced Streaming value is dependent on both host behavior, host transfer rate and compression ratio on data actually written. Fine-tuning should be done on “ real life systems” with “ real life data” .

2.10. Recorded Objects

The recording formats [9] - [14] specify that recorded elements (blocks and tapemarks) have identifiers included in the recorded information to help determining the write sequence and also to help detecting positioning errors. These identifiers are unique within the whole volume.

The identifiers are associated with physical blocks only. This means that a possible logical block number maintained by the host system will not be the same as the physical identifier of the same logical block because logical blocks may span over multiple physical blocks.

The physical identifiers are normally not visible to the host system. There are, however, some exceptions. In the Tandberg SLR Product Line Tape Drives, the READ POSITION and LOCATE commands may transfer physical block identifiers to/from the host system. The host system is, however, not expected to process this data in any way. The identifiers transferred from the Drive by the READ POSITION command should just be stored and then transferred unmodified back to the Drive at some future time by the LOCATE command.

2.11. TapeAlert

The TapeAlert information is accessed via LOG SENSE page 2Eh (see section 13.3.5 TapeAlert Page), and configuration is done via MODE SELECT page 1Ch (see section 14.3.9 Informational Exceptions Control Page). The Mode Sense/Select configuration of the TapeAlert interface is compatible with the SMART diagnostic standard for disc drives. The host software should first check the tape drive to determine whether it supports the TapeAlert Log Sense page 2Eh. By default the host software access to the TapeAlert Log Sense page is via polling.

The TapeAlert Log Sense page shall be read from a tape drive device at the following times as a minimum:

- At the beginning of a write/read job, even if media is not loaded.
- Immediately after a fatal error during the write/read job.
- At the end of each tape when the write/read job spans multiple tapes. If the tape is to be ejected then the Log Sense page must be read BEFORE this.
- At the end of a write/read job.

Though not mandatory, the host software may also poll the Log Sense page at regular intervals (e.g. every 60 seconds) while the tape drive is idle.

The TapeAlert Log page contains 64 one-byte alert flags. The specific conditions for any one flag to be set and cleared are defined in section 13.3.5.

There are three flag severity levels, listed below in order of severity:

- Critical (C)
- Warning (W)
- Information (I)

Each time the host software reads the TapeAlert Log page, it should check all 64 flags to discover which are set (there may be more than one). The definitions of the 64 flags are device type specific, so that there is one definition for tape drive devices, and a different definition for stand-alone changer devices (in libraries). For each flag that is set, the host software shall communicate the defined error message and severity for that flag to the user, and also log it. If multiple flags are set simultaneously, they will be displayed together in ascending order of severity. At the beginning of each set of TapeAlert error messages, the tape device that initiated them must be identified. For the tape drive media-related flags (flags 4, 7 and 14) the software label of the media, if such exist, should be included in the TapeAlert error messages so that the user is aware what piece of media the error refers to. Such information could also be displayed with the messages for other flags as well if required. The information read in the TapeAlert flags should not in itself cause the software to stop a current backup/restore job.

3. Logical Characteristics

3.1. SCSI-bus Phases

The Drive implements the following SCSI-bus phases:

Bus management phases	Information transfer phases
BUS FREE ARBITRATION SELECTION RESELECTION	COMMAND DATA-IN DATA-OUT STATUS MESSAGE-IN MESSAGE-OUT

Table 3-1: SCSI-bus Phases

The SCSI-bus will never be allowed to be in more than one phase at any given time. See also [2], [5] and [6]. See also [1] for timing diagrams showing SCSI-bus signal activity.

3.1.1. Bus Management Phases

3.1.1.1. Bus Free Phase

The BUS FREE phase is used to indicate that no SCSI device is actively using the SCSI-bus and that it is available for subsequent users.

The Drive enters the BUS FREE phase by releasing BSY after one of the following conditions:

- *after a SCSI-bus RESET condition*
- *after an ABORT message has been received*
- *after a BUS DEVICE RESET message has been received*
- *after a DISCONNECT message has been transmitted*
- *after a COMMAND COMPLETE message has been transmitted*
- *after certain SCSI protocol errors (see section 6.6 Unexpected Bus Free)*

The Drive enters the BUS FREE phase by releasing SEL after the following condition:

- *after an unsuccessful reselection of an Initiator*

3.1.1.2. Arbitration Phase

The Arbitration phase allows the drive to gain control of the SCSI-bus so that it can resume or initiate the connection with an other device on the bus.

3.1.1.3. Selection Phase

The Selection phase allows the Initiator to select the drive for the purpose of having the Drive execute a command or physical path management function.

3.1.1.4. Reselection Phase

The Reselection phase allows the Drive to reconnect to an initiator for the purpose of continuing some operation that was previously started by that initiator, but was suspended by the Drive (e.g. it disconnected).

When attempting to reselect its Initiator, the Drive implements the recommended Reselection Time-out Delay according to ANSI [2] and [6].

If Reselection does not succeed, the Drive considers the current command for terminated (as if an ABORT message had been received). Buffered data will continue to be written to the tape if the time-out occurs during a write operation. Immediate commands will continue their execution. No sense data error information will be generated. A new command from the same or any other Initiator will execute normally (as if no time-out had occurred).

3.1.2. Information Transfer Phases

3.1.2.1. Command Phase

The COMMAND phase is used by the Drive to request command information from the Initiator.

The Drive transfers either six (Group 0 commands) or ten (Group 1 commands) command bytes in one single Command Phase.

3.1.2.2. Data In/Out Phases

The DATA-IN phase is used by the Drive to request that data is sent from the Drive to the Initiator.

The DATA-OUT phase is used by the Drive to request that data is sent from the Initiator to the Drive.

Synchronous and asynchronous Data Transfer are supported. 8 bit and 16 bit wide SCSI-busses are supported.

3.1.2.3. Status Phase

The STATUS phase is used by the Drive to request that status information is sent from the Drive to the Initiator.

3.1.2.4. Message-In/Out Phases

The MESSAGE-IN phase is used by the Drive to request message(s) be sent from the Drive to the Initiator.

The MESSAGE-OUT phase is used by the Drive to request message(s) be sent from the Initiator to the Drive.

3.2. SCSI-bus Phase Sequences

The order in which phases are used on the SCSI-bus follows a prescribed sequence. The RESET condition however can abort any phase and is always followed by the BUS FREE phase.

The sequences allowed by the SCSI standard are shown in the figure below. The normal progression is:

- *From the BUS FREE phase to ARBITRATION*
- *From ARBITRATION to SELECTION or RESELECTION*

  and

- *From SELECTION or RESELECTION to one or more of the information transfer phases (COMMAND, DATA-IN/OUT, STATUS, or MESSAGE-IN/OUT)*

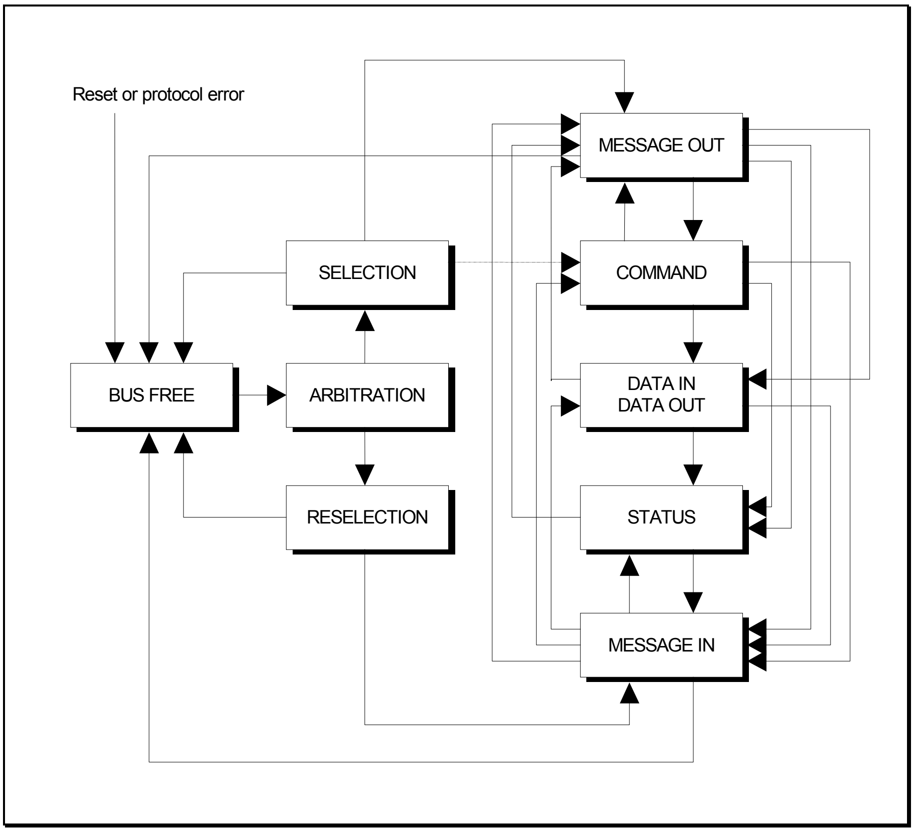

Figure 3-1: Phase Sequencing

Arbitration and Selection are always controlled by the Initiator. Once the Target is selected however, the Target controls the phase sequencing between the information transfer phases. If the Initiator wants to interrupt by sending a message to the Target, it may assert ATN.

3.2.1. Legal Phase Sequences

The sequences depend on the command(s) and the use of the ATN condition by the Initiators. The different command sections (sections 8 through 31) detail the possible sequences of each command.

3.2.1.1. Notation

The notation used in the sequences is called *Backus-Naur Form* or BNF. The elements of the notation used in this manual are as follows:

::= *Rewriting rule or production*. This symbol is read as *'is defined as'* or *'can be replaced by'*.

| *Or.* This symbol separates alternative definitions.

< > *Angle brackets* are used to delimit the name of a defined sequence, e.g. <sequence>. Where it is defined, the name of a sequence is set in boldface.

{ } *Braces* are used to denote a possible repetition of the enclosed symbols – one ore more times.

CAPS The names of the different SCSI-bus phases are set in capital letters.

3.2.1.2. Sequence Elements

The sub-sequences or sequence elements shown below will be used in the different command sections to describe the actual sequences that are possible for each command.

<initiator-part> ::= BUS-FREE ARBITRATION SELECTION

The Initiator initiates a new connection by first waiting for the BUS FREE phase, then by arbitrating for the bus and – when the bus has been won – finally by selecting the Drive.

<message-out> ::= MESSAGE-OUT |

MESSAGE-OUT <message-out> |

MESSAGE-OUT MESSAGE-IN <message-out> |

MESSAGE-OUT BUS-FREE

A message-out sequence may transfer a single message or multiple messages. The message-out sequence may also include some message-in phases (as may be the case when the Drive rejects a message out). Finally the message-out sequence may end up in a BUS FREE phase (as it will after messages like ABORT or RESET).

<message-in> ::= MESSAGE-IN |

MESSAGE-IN <message-out>

A message-in sequence may transfer a message to the Initiator. After the message-in transfer a message-out may also occur (as may be the case when the Initiator rejects or aborts a message-in).

<selection> ::= <initiator-part> <message-out>

Note that the SCSI-2 and SCSI-3 specifications both call for a message out phase transferring an IDENTIFY message [2], [5].

<command> ::= COMMAND |

COMMAND <message-out>

The command sequence transfers a complete CDB (6 or 10 bytes). A message out sequence will follow if the Initiator asserts ATN during the command transfer.

<data-in> ::= DATA-IN |

DATA-IN <message-out>

The data in sequence transfers one or more data bytes from the Drive to the Initiator. A message out sequence will follow if the Initiator asserts ATN during the data transfer.

<data-out> ::= DATA-OUT |

DATA-OUT <message-out>

The data out sequence transfers one or more data bytes from the Initiator to the Drive. A message out sequence will follow if the Initiator asserts ATN during the data transfer.

<status> ::= STATUS |

STATUS <message-out>

The status sequence transfers a single status byte to the Initiator. A message out sequence will follow if the Initiator asserts ATN during the status transfer.

<completed> ::= <status> <message-in> BUS-FREE

When an unlinked command has completed execution, the Drive transfers a status byte and a message byte and goes to BUS FREE.

<completed-link> ::= <status> <message-in>

When a linked command has completed execution, the Drive transfers a status byte and a message byte. The bus is not going to BUS FREE.

<disconnect> ::= < message-in> BUS-FREE |

<message-in> < message-in> BUS-FREE

When the Drive disconnects it may send one or two message in bytes before going to the BUS FREE phase. When transferring a single message, this will be a DISCONNECT message. When transferring two messages, the first message will be a SAVE DATA POINTER message. The second message will be a DISCONNECT message. The Drive sends a single message when it disconnects after having transferred a CDB. It sends two messages in all other cases.

<reconnect> ::= BUS-FREE ARBITRATION RESELECTION <message-in>

The Drive reconnects to the Initiator by waiting for BUS FREE, arbitrating for the bus and then by performing the reselection. A single message in byte follows. This will be an IDENTIFY message with the Disconnect Privilege bit set to zero and with a zero LUN field.

3.2.1.3. Disconnects/Reconnects

Disconnection is the process of going through one or two MESSAGE-OUT phases and then to the BUS FREE phase in the middle of a command execution. When the Drive has disconnected, it will always try to reconnect at a later time. Reconnection is the process of going from the BUS FREE phase to the ARBITRATION phase, RESELECTION and MESSAGE-IN phase.

When disconnecting, the first of possibly two messages transferred will be a SAVE DATA POINTER message. The second or only message will be a DISCONNECT message. The Drive will then enter the BUS FREE phase.

When reconnecting, the message transferred will be an IDENTIFY message with the Disconnect Granted bit (Bit 6) set to zero. The six LUN bits will also be set to zero.

All commands except INQUIRY, REQUEST SENSE and TEST UNIT READY will disconnect if the Initiator grants disconnection. The first disconnect will always occur immediately after the CDB transfer.

Please refer to the section for each command to see if and when during the execution the command disconnects/reconnects.

3.2.1.4. Command Linking

Normally the Drive goes to the BUS FREE phase after a successful command completion. The Drive transfers the GOOD status byte and the COMMAND COMPLETED message before entering the BUS FREE phase.

If the initiator wants the Drive to go directly to a new COMMAND phase after successful command completion, the initiator has to link the commands. The Drive than transfers an INTERMEDIATE status byte followed by a LINKED COMMAND COMPLETE (or LINKED COMMAND COMPLETE W/FLAG) message byte before entering the COMMAND phase. The Drive expects immediately the transfer of a new command.

To link a command the Link bit has to be set to one in the Control Byte of the Command Descriptor Block (refer to section 4.2).

The command link function will operate as long as commands complete successfully and the link bit is set. When some error has been detected (any other than GOOD status would have been transferred for a non-linked command), the link will be broken, and the failing command will be terminated with the proper status byte and then with a COMMAND COMPLETE message byte.

Command linking modifies the command phase sequencing:

The first command in a series of linked commands will follow the prescribed phase sequence except that the <completed-link> sub-sequence will be used instead of the usual <completed> sub-sequence.

The second and every other command except the last will skip the <initiator-part> sub-sequence and go directly to the <command> sub-sequence. A <completed-link> sub-sequence will be used instead of the usual <completed> sub-sequence.

The last command in a series of linked commands will skip the <initiator-part> sub-sequence and go directly to the <command> sub-sequence.

Here is a simple example with three commands. The first two have their Link bits set to one.

<sequence-link> ::= <initiator-part> <command-1> <completed-link> <command-2> <completed-link> <command-3> <completed>

3.3. SCSI Pointers

The SCSI architecture provides for two sets of three pointers within each Initiator. The first set of pointers is known as the *current* (or active) pointers. The second set of pointers is known as the *saved* pointers.

There are three kind of pointers in a pointer set. There are pointers pointing to a *command*, *data* or *status* area in the memory of the Initiator.

The pointers in the current pointer set are used to represent the state of the interface and point to the command, data and status byte to be transferred between the Initiator memory area and the Target for the current connection. There is only one set of current pointers in each Initiator. The current pointers are valid for the Target currently connected to the Initiator.

The pointers in the saved pointer sets represent the state of each command that the Initiator has active (whether or not it is currently connected). If the Initiator for instance has four different commands active in one or more targets (including the currently connected command), there will be four complete sets of saved pointers stored in the Initiator.

The *saved command pointer* always points to the start of the Command Descriptor Block for the current command.

At the beginning of each command, the *saved data pointer* points to the start of the data area. It remains at this value until the Target sends a SAVE DATA POINTER message to the Initiator. In response to this message, the Initiator stores the value of the current data pointer into the saved data pointer.

The *saved status pointer* always points to the start of the status area for the current command.

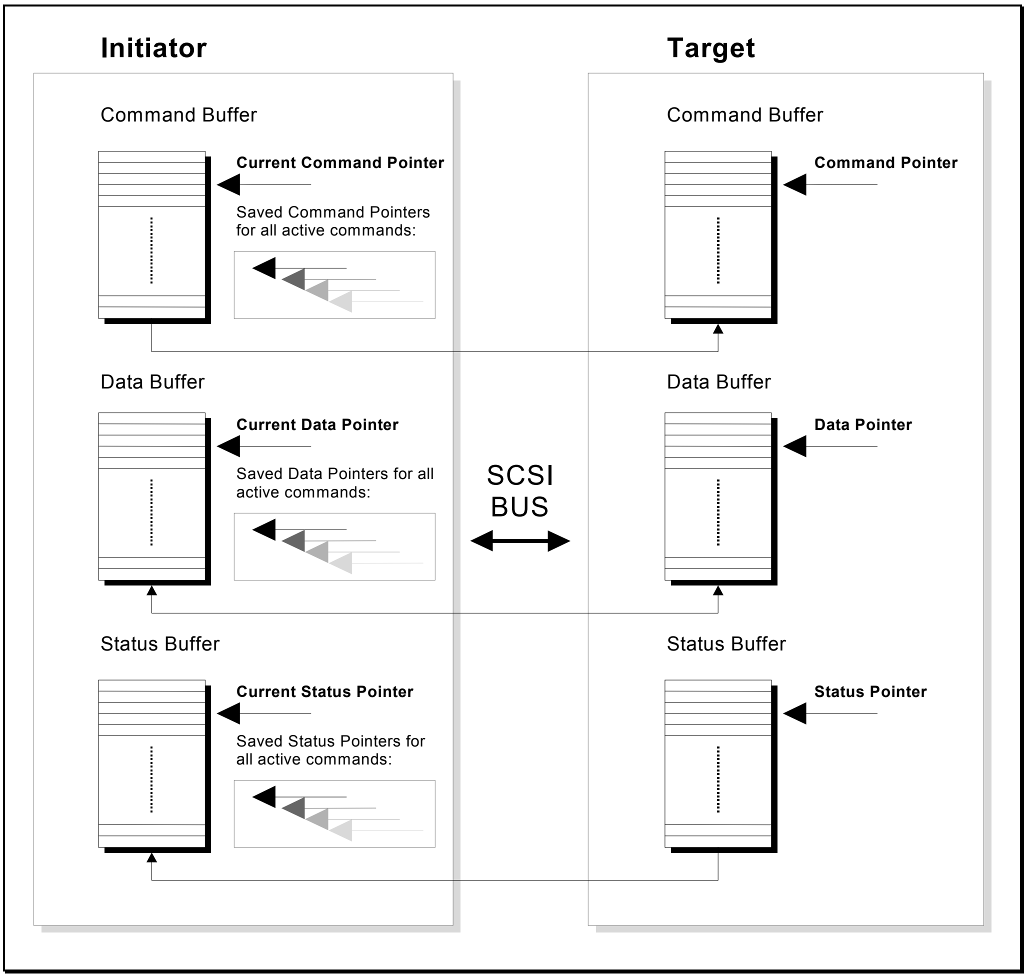

Figure 3-2: SCSI Pointers

The Target may restore the current pointers to their saved values by sending a RESTORE POINTERS message to the Initiator. The Initiator moves the saved value of each pointer into the corresponding current pointer.

Whenever a SCSI device disconnects from the bus, only the saved pointer values are retained. The current pointer values are restored from the saved values automatically upon the next reconnection.

3.4. Unit Attention

The Unit Attention Condition is created for each initiator whenever

- *A new cartridge has been inserted*
- *LOG SELECT parameters have been changed by another Initiator*
- *MODE SELECT parameters have been changed by another Initiator*
- *The Drive microcode (ucode) has been changed*
- *A hard reset has occurred (either through the SCSI-bus RST line or through processing of a BUS DEVICE RESET message)*
- *A power-on reset has occurred*
- *A LOG threshold condition has been met.*

The Unit Attention Condition will persist for each Initiator until that Initiator clears the condition as described in the following paragraphs.

If an Initiator issues a command other than INQUIRY or REQUEST SENSE while a Unit Attention condition exists for that Initiator (prior to reporting CHECK CONDITION for the Unit Attention condition), the Drive will not perform the command and will report CHECK CONDITION status unless a BUSY or RESERVATION CONFLICT status (higher priority status) is also pending.

After reporting CHECK CONDITION status, the next command received from that Initiator should be REQUEST SENSE. Otherwise the Unit Attention condition will be cleared for that Initiator, the Drive will perform the command and report GOOD status.

If a REQUEST SENSE command is received after the Drive has reported CHECK CONDITION status to this Initiator for Unit Attention condition, the Drive will report UNIT ATTENTION Sense Key, and then clear the Unit Attention condition for that Initiator.

If a REQUEST SENSE command is received from an Initiator with a pending Unit Attention condition (before the Drive reports CHECK CONDITION), the Drive will discard any pending sense data, report UNIT ATTENTION Sense Key, and then clear the Unit Attention condition for that Initiator.

If an INQUIRY command is received with a pending Unit Attention condition (before the Drive reports CHECK CONDITION status), the Drive will perform the INQUIRY command, report GOOD status, and will **not** clear the Unit Attention condition. If the INQUIRY command is received after the Drive has reported CHECK CONDITION for a pending Unit Attention condition, then the Unit Attention condition will be cleared and the Drive performs the INQUIRY command.

3.5. SCSI-bus Conditions

3.5.1. Attention (ATN)

The ATTENTION condition allows an Initiator to inform a Target that the Initiator has a message ready. The Drive may get this message by performing a MESSAGE-OUT phase.

The Initiator creates the ATTENTION condition by asserting ATN at any time except during the ARBITRATION or BUS FREE phases.

The Initiator must assert the ATN signal before releasing ACK for the last byte transferred in a bus phase for the ATTENTION condition to be honored before transition to a new bus phase. An ATN asserted later might not be honored until a later bus phase and then may not result in the expected action.

The Initiator must keep ATN asserted if more than one message byte is to be transferred.

The Initiator may negate the ATN signal at any time except while the ACK signal is asserted during a MESSAGE-OUT phase. Normally, the Initiator negates ATN while REQ is true and ACK is false during the last REQ/ACK handshake of the MESSAGE-OUT phase.

If ATN occurs during a COMMAND phase, MESSAGE-OUT will occur after transfer of all Command Descriptor Block bytes has been completed.

If ATN occurs during a DATA IN or OUT phase while transferring parameters of a:

- ***INQUIRY***
- ***LOG SELECT***
- ***LOG SENSE***
- ***MODE SELECT***
- ***MODE SENSE***
- ***READ BLOCK LIMITS***
- ***READ POSITION***
- ***RECEIVE DIAGNOSTIC RESULTS***
- ***REQUEST SENSE***

or

- ***SEND DIAGNOSTICS***

command,

MESSAGE-OUT will occur after transfer of the complete Parameter List.

If ATN occurs during a DATA phase of a:

- ***READ***
- ***READ BUFFER***
- ***VERIFY***
- ***WRITE***

or

- ***WRITE BUFFER***

command,

MESSAGE-OUT will occur after transfer of no more data than given by the *Maximum Burst Size* parameter in the Disconnect/Reconnect Page of the MODE SELECT command.

If ATN occurs during a STATUS phase, MESSAGE-OUT will occur after the status byte has been acknowledged by the Initiator.

If ATN occurs during a MESSAGE IN phase, MESSAGE-OUT will occur after the message byte has been acknowledged by the Initiator.

If ATN occurs during a SELECTION phase and before the Initiator releases the BSY signal, MESSAGE-OUT will occur immediately after the SELECTION phase.

If ATN occurs during a RESELECTION phase, MESSAGE-OUT will occur after the Drive has successfully sent it's IDENTIFY message for that RESELECTION phase.

3.5.2. Reset

The RESET condition is used to immediately clear all SCSI devices from the bus. This condition will take precedence over all other phases and conditions. Regardless of prior bus phase, the bus enters the bus free phase. Any SCSI device may create the reset condition by asserting the RST signal.

The Drive will never create a RESET condition.

The Drive is reset under the following conditions:

- *At Power-on*
- *When RST is asserted by one of the devices on the SCSI-bus*
- *When a BUS DEVICE RESET message is sent to the drive*
- *When the Drive microcode (ucode) is updated*
- *Internal watchdog function detecting uncorrectable hardware or software errors*

The Drive only supports the SCSI Hard Reset option.

3.5.2.1. Hard Reset

When the Drive detects a hard reset condition it will do the following:

- *Release all SCSI-bus signals and go to BUS FREE.*
- *Clear all non-completed commands*
- *Release all SCSI-device reservations*
- *Return all SCSI device operating modes to their saved values (MODE SELECT) or default values (PREVENT/ALLOW MEDIUM REMOVAL). The non-savable Log Parameters will be cleared to zero. The savable Log Parameters will remain unchanged, unless the Hard Reset is a result of a Power-up condition. In this case the savable Log Parameters will be initialized to their saved values.*
- *Position the media to BOM - if the drive has a cartridge inserted when the reset condition occurred.*
- *UNIT ATTENTION condition will be set for all Initiators (see Section 3.4. Unit Attention)*

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4. Commands

4.1. The Command Descriptor Block

A request to the Drive is performed by sending a Command Descriptor Block. For some commands the request is accompanied by a list of parameters sent during the DATA-OUT phase.

The Drive will support Group 0 and Group 1 commands [2], [3], [4], [7]. Group 0 commands have 6 bytes in the Command Descriptor Block. Group 1 commands have 10 bytes in the Command Descriptor Block.

Examples of Six-Byte and Ten-Byte Command Descriptor Blocks are shown in the two following tables:

BYTE	BIT 7	6	5	4	3	2	1	0
00	Operation Code							
01	Logical Unit Number (LUN)			Parameters				
02	Parameters							
03	Parameters							
04	Parameters							
05	Control Byte							

Table 4-1: Typical Six-byte Command Descriptor Block

BYTE	BIT 7	6	5	4	3	2	1	0
00	Operation Code							
01	Logical Unit Number (LUN)			Parameters				
02	Parameters							
03	Parameters							
04	Parameters							
05	Parameters							
06	Parameters							
07	Parameters							
08	Parameters							
09	Control Byte							

Table 4-2: Typical Ten-byte Command Descriptor Block

Operation Code

The Command Descriptor Block always has an operation code as the first byte of the command. See Section 4.4. for operation codes supported by the Drive.

LUN

The Drive supports only one Logical Unit Number (LUN). This field should/must be set to zero in all Command Descriptor Blocks for the Drive.

The Drive is a SCSI-1/2 compliant device. The Drive will ignore the LUN specified in the CDB if an IDENTIFY message was received. It is recommended that the LUN in the CDB be set to zero. See section *4.6.3. Commands Received Serially, LUN Not 0* for a description of the response to non-zero LUN values.

Parameters

See the specific commands for detailed information on the various parameter bytes.

Control Byte

See Section 4.2. for details on the Command Control Byte.

4.2. Command Control Byte

The Control Byte is the last byte of every Command Descriptor Block. A typical Control Byte is shown below.

BYTE	BIT 7	6	5	4	3	2	1	0
Last Byte	X	X	RESERVED			NACA	Flag	Link

Table 4-3: The Command Control Byte

X

Bits 6 and 7 are ignored by the Drive. The only exception is the SPACE command which uses control byte bit 7 as its FAST option bit.

RESERVED

These bits MUST always be set to zero.

NACA

The Normal ACA (NACA) bit must be set to zero.

Link

If the Link bit is set, an automatic link to the next command is made at a successful completion of the current command. The Drive first returns INTERMEDIATE status for the current command (instead of GOOD status), it then returns one of two linked command complete messages (as described under Flag below) before going directly to another Command Phase (there is no Bus Free phase in between commands).

When the Link bit and the IMMediate bit of a command (where applicable) are both set to one, the Drive returns CHECK CONDITION status. The Error Code is set to INVALID FIELD IN CDB.

Flag

The Flag bit is only meaningful when the Link bit is set to one. If both bits are set, a LINKED COMMAND COMPLETE WITH FLAG message byte is sent after the INTERMEDIATE status byte. If only the Link bit is set, a LINKED COMMAND COMPLETE message byte is sent after the INTERMEDIATE status byte.

If only the Flag bit is set (the Link bit is zero), the Drive returns CHECK CONDITION status. The Error Code is set to INVALID FIELD IN CDB.

4.3. Reserved Fields

Reserved bits, fields, bytes and code values are set aside for future standardization. These bits, fields or bytes have to be set to zero. They are marked with the word RESERVED or the letter R in the Command Descriptor Blocks and Parameter Lists. If the Drive receives a reserved bit, field, byte that is not zero or receives a reserved code value, it will terminate the command with a CHECK CONDITION status.

If the offending bit, field, byte or code is located in a Command Descriptor Block, then the whole Command Descriptor Block (6 or 10 bytes) will be transferred before the command is terminated with CHECK CONDITION and the Error Code will be set to INVALID FIELD IN CDB.

If the offending bit, field, byte or code is located in a Parameter List, then the whole Parameter List will be transferred before the command is terminated with CHECK CONDITION and the Error Code will be set to INVALID FIELD IN PARAMETER LIST.

4.4. Command Set Summary

The Tandberg SLR Product Line Tape Drives supports the SCSI commands listed in the following table.

Description	Group	Media	Type	Operation Code
ERASE	M	Yes	M	19h
INQUIRY			M	12h
LOAD/UNLOAD	M	Yes	O	1Bh
LOCATE	N	Yes	O	2Bh
LOG SELECT			O	4Ch
LOG SENSE			O	4Dh
MODE SELECT		[2]	M	15h
MODE SENSE			M	1Ah
PREVENT/ALLOW MEDIA REMOVAL		Yes	O	1Eh
READ	R	Yes	M	08h
READ BLOCK LIMITS			M	05h
READ BUFFER			O	3Ch
READ POSITION	R		O	34h
RECEIVE DIAGNOSTIC RESULTS			O	1Ch
RELEASE			M	17h
REQUEST SENSE			M	03h
RESERVE			M	16h
REWIND	M	Yes	M	01h
SEND DIAGNOSTICS		[3]	M	1Dh
SPACE	N	Yes	M	11h
TEST UNIT READY			M	00h
VERIFY[1]	R	Yes	O	13h
WRITE	W	Yes	M	0Ah
WRITE BUFFER			O	3Bh
WRITE FILEMARKS	W	Yes	M	10h

Table 4-4: SCSI Command Set

The ***Command Group*** is used to specify legal (and illegal) command sequences (see also Section 4.5).

[1] Not supported by the Tandberg SLR7 and SLR140

[2] The MODE SELECT command is a media access command only when the Device Configuration Page with the CAP bit set to one or when the Medium Partition Page(1) are included in the parameter list.

[3] When executing a Selftest 1, the SEND DIAGNOSTICS is not a media access command. When executing Selftest 2 the SEND DIAGNOSTICS is a media access command.

Group M These are Move Type commands.

Group R These are Read Type commands. Data is read off the tape during command execution.

Group N These are Navigate Type commands. Data is read off the tape during command execution, but no data transfer takes place on the SCSI-bus.

Group W These are Write Type commands. Data is written to the tape during command execution.

All other commands These are Neutral commands.

Commands marked with **“ Yes”** in the **Media** column are called *Media Access Commands*. The Drive will terminate the command with CHECK CONDITION status if any media access command is issued with no cartridge loaded. A cartridge is loaded when it is inserted and the Auto Load option is enabled or a LOAD/UNLOAD command has been executed with the Load bit set to one.

The ***Command Type*** is defined by the SCSI-standards [2] [3] [7] like this:

Type M These commands must be implemented by a sequential access device in order to meet the minimum requirements.

Type O These commands are optional for sequential devices.

4.5. Command Sequencing

Usually the Initiator must issue a sequence of SCSI commands to be able to have the Drive perform a certain operation. As a general rule any sequence of SCSI commands is legal. There are, however, a few exceptions.

The tape and buffer system in the Drive can be in one of 4 different normal modes. In addition there are some exception modes. The Drive changes modes before starting to execute certain commands. The Drive may enter one of the exception modes when a command has failed. The action taken by the Drive when a command is received depends on the current mode. For the discussion of modes the command set is grouped into 5 different command groups according to the command mode specified in Section 4.4.

4.5.1. Normal Modes

There are 4 different normal modes. The default mode after power-up or reset is always MOVE. The Drive also enters MOVE mode when a new cartridge is inserted.

MOVE The Drive attempts to enter the MOVE mode when a command from the move-group has been received. In this mode the data buffer is not used.

READ The Drive attempts to enter the READ mode when a command from the read-group has been received. The data buffer system is set up to transfer data and tapemarks from the tape to the SCSI-bus.

NAVIGATE The Drive attempts to enter the NAVIGATE mode when a command from the navigate-group has been received. The data buffer system is set up to transfer data and tapemarks from the tape.

WRITE The Drive attempts to enter the WRITE mode when a command from the write-group has been received. The data buffer system is set up to transfer data (WRITE commands) or tapemarks (WRITE FILEMARKS commands) from the SCSI-bus to the tape.

The action taken by the Drive when a command is received depends on the current mode. Commands from one group can always follow a command from the same group with no special action taken. Note also that neutral-group commands can be inserted into any sequence of commands as they do not change the Drive's mode. When a command from one group follows a command from another group the Drive usually takes special action. In a few cases going from one group to another is not allowed. The command from the new group is then not executed at all. Instead it is just terminated with CHECK CONDITION.

The following table shows the actions taken by the Drive when a command from a certain group is received in the different normal modes:

Current Mode	Next Command	Actions
MOVE	move-group	No action. The move-group command is executed.
	read-group	The buffer system is re-initialized (all buffered data is lost). The Drive then calibrates the head position. The Density Code is updated. The read-group command is executed.
	navigate-group	The buffer system is re-initialized (all buffered data is lost). The Drive then calibrates the head position. The Density Code is updated. The navigate-group command is executed.
	write-group	The Drive waits until the cartridge type is known. If the cartridge type is suited for the selected tape format (Density Code) the buffer system is re-initialized (all buffered data is lost). If the tape format requires so the Drive then seeks the tape edge and writes the tape reference burst. The Density Code is updated. The write-group command is executed.
READ	move-group	The Drive stops any read-ahead operation. The buffer system is re-initialized (all read-ahead data is lost). The move-group command is then executed.
	read-group	No action. The read-group command is executed.
	navigate-group	The Drive just enters NAVIGATE mode. The navigate-group command is executed.
	write-group	Since overwrite is illegal, the Drive will check if the tape is logically positioned at end-of-data (EOD). If the tape is not at EOD then the write-group command is terminated immediately with CHECK CONDITION status and the Error Code is set to WRITE APPEND ERROR (Write After Read). The Drive continues to be in READ mode. If the tape is at EOD, or if overwrite is legal, the write-group command is executed. New data will be appended, beginning from the current position.
NAVIGATE	move-group	The Drive stops any read-ahead operation. The buffer system is re-initialized (all read-ahead data is lost). The move-group command is then executed.
	read-group	The Drive just enters READ mode. The read-group command is executed.
	navigate-group	No action. The navigate-group command is executed.
	write-group	The Drive will check if the tape is logically positioned at end-of-data (Logical End Of Partition). If the tape is at EOD then the write-group command is executed. This will append new data after the last written block on the tape. If the tape is not at EOD then the write-group command is terminated immediately with CHECK CONDITION status and the Error Code is set to WRITE APPEND ERROR (Write After Read). The Drive continues to be in NAVIGATE mode.

Table 4-5: Normal Mode Actions (to be continued...)

Current Mode	Next Command	Actions
WRITE	move-group	Data and tapemarks remaining in the data buffer are written to the tape. If this operation is successful the Drive enters the MOVE mode. The move- group command is executed.
	read-group	The Drive terminates the read-group command immediately with CHECK CONDITION status. The Error Code is set to either END-OF-DATA DETECTED or END-OF-DATA DETECTED AFTER LEW depending on whether the tape is positioned before or after LEW. The Drive continues to be in WRITE mode.
	navigate-group	If the navigate-group command is a SPACE forward command, the Drive terminates the command immediately with CHECK CONDITION status. The Error Code is set to either END-OF-DATA DETECTED or END-OF-DATA DETECTED AFTER LEW depending on whether the tape is positioned before or after LEW. The Drive continues to be in WRITE mode. In other cases the Drive enters NAVIGATE mode and the navigate-group command is executed.
	write-group	A test is made to see if the current Density Code (tape format) has changed. The write-group command is executed if the tape format has not changed.

Table 4-5: Normal Mode Actions

4.6. Multiple Connections

4.6.1. Background

While the SCSI-bus is in the BUS FREE state, any Initiator may attempt a connection to the Drive. In most cases this will happen when the Drive has completed execution of some previous command (a STATUS byte and a COMMAND COMPLETED message has been sent). As soon as the SCSI-bus becomes free, an Initiator may again select the Drive. The Drive will respond to the selection and a new command may be transferred and later executed by the Drive. This is the usual scenario where commands are executed in a *serial* manner. The connecting Initiators may be the same or different Initiators.

If allowed, the Drive may disconnect from the current Initiator during command execution. The Drive reconnects automatically at a later stage, but this will temporarily leave the SCSI-bus in the BUS FREE state, even if the current command has not completed its execution. During these periods of BUS FREE phases, any Initiator (including the original), may seize the opportunity to select the Drive. In a multiple-initiator system, one Initiator may not even know that another Initiator already has established a connection to the Drive. When the Drive is logically connected to *two Initiators* at the same time (or the same Initiator *twice),* a *concurrent* command situation exists.

Regardless of whether a concurrent command situation exists or not, the different (or same) Initiator may connect to the same or different LUNs within the Drive. Even if the Drive only has a single LUN (LUN 0 (zero)), attempts may be made to connect to other LUNs.

We have the following combinations of Initiator Ids, LUNs and concurrent/serial command execution:

Serial/Concurrent	Connecting Initiator	Specified LUN	See Section
Serial Commands	Any Initiator	0	4.6.2
		Other than 0	4.6.3
Concurrent Command	Same as original Initiator	0	4.6.4
		Other than 0	4.6.5
	Different Initiator	0	4.6.6
		Other than 0	4.6.5

Table 4-6: Connections, LUN and Initiator ID Combinations

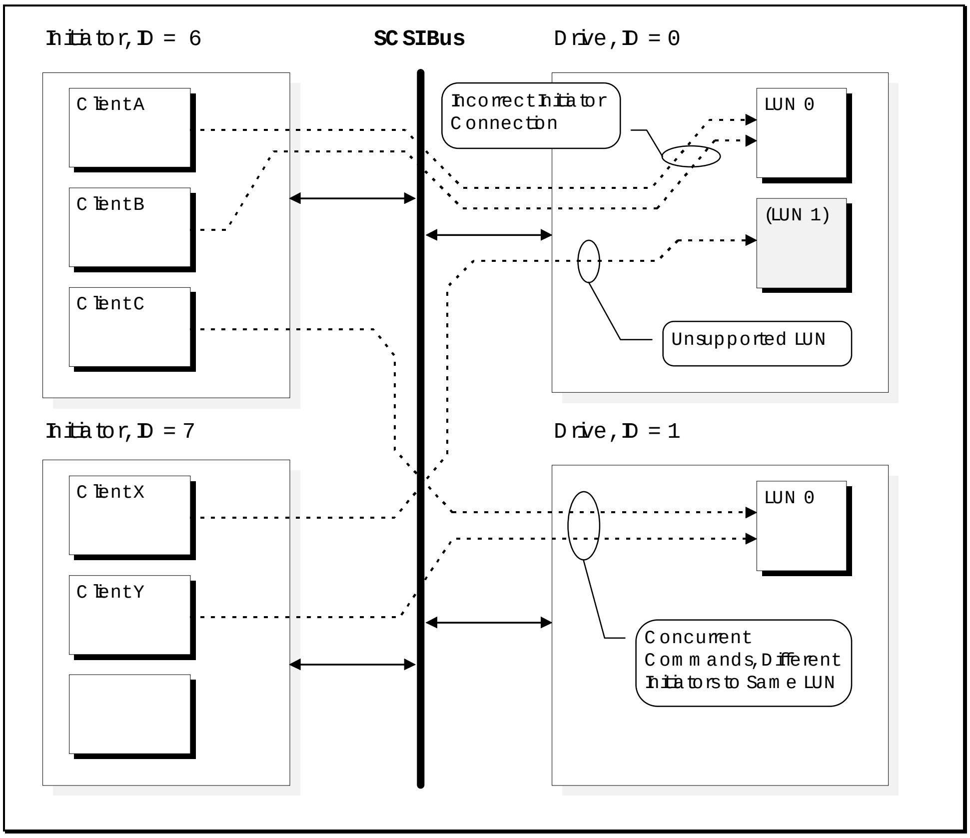

Figure 4-1: Connections, Some Examples

4.6.2. Commands Received Serially, LUN Is 0

When the drive is not engaged in any command execution any initiator may select the Drive. The Drive will respond to the selection, the Initiator may send a new command, which later will be executed by the Drive.

4.6.3. Commands Received Serially, LUN Not 0

The Drive responds to the selection and a new command may be transferred. If the command is an INQUIRY or REQUEST SENSE command it will be executed. The parameter data returned will however reflect an UNSUPPORTED LUN condition (see the INQUIRY and REQUEST SENSE command sections for details). All other commands will be terminated immediately with CHECK CONDITION status. The error code generated will be UNSUPPORTED LUN.

4.6.4. Concurrent Command, Same Initiator, LUN Is 0

The Drive will respond to the selection. If the Initiator does not send an ABORT or a BUS DEVICE RESET message during the same MESSAGE OUT phase as the IDENTIFY message, and *Incorrect Initiator Connection* condition exists [2], [5].

When the Drive detects an Incorrect Initiator Connection the Drive aborts the command already executing (the original command that disconnected) and terminates the current command with CHECK CONDITION status. The error code generated will be OVERLAPPED COMMANDS ATTEMPTED.

4.6.5. Concurrent Command, Any Initiator, LUN Not 0

The Drive responds to the selection and a new command may be transferred. If the command is an INQUIRY or REQUEST SENSE command it will be executed. The parameter data returned will however reflect an UNSUPPORTED LUN condition (see the INQUIRY and REQUEST SENSE command sections for details). All other commands will be terminated immediately with CHECK CONDITION status. The error code generated will be UNSUPPORTED LUN.

4.6.6. Concurrent Command, Different Initiator, LUN Is 0

The Drive will respond to the selection and the Initiator may send a new command. If the command is one of the following commands,

- INQUIRY,
- REQUEST SENSE,
- TEST UNIT READY,

it will be executed as normal (concurrently with the command already executing in the Drive). All other commands are terminated with a BUSY status.

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5. Status Bytes

A status byte will be sent from the Drive to the Initiator during the STATUS phase at the termination of each command unless the command is cleared by an ABORT message, by a BUS DEVICE RESET message or a SCSI-bus reset condition.

The Drive supports the Status Bytes shown in the table below:

Status Byte Name	Hex Code
BUSY STATUS	08
CHECK CONDITION STATUS	02
GOOD STATUS	00
INTERMEDIATE STATUS	10
RESERVATION CONFLICT STATUS	18

Table 5-1: The Status Set

BUSY Status

The command can be accepted, but it can not be executed because the Drive is busy.

Three different BUSY situations may occur:

1) The drive is already executing a command from another initiator and the new command can't be executed in parallel.

2) The Drive is executing an Immediate-type command (from any initiator) and the BSYI-option is turned on (please refer to the BSYI-bit in the Miscellaneous Parameters Page of the MODE SELECT command). This condition will prevail until the Immediate-type command has completed its execution (or the BSYI-option is turned off).

3) The drive is occupied by a drive-initiated preparation activity (as e.g. Autoload) and the BSYA-option is turned on (please refer to the BSYA-bit in the Miscellaneous Parameters Page of the MODE SELECT command). This condition will prevail until the drive-initiated activity has completed (or the BSYA-option is turned off).

CHECK CONDITION Status

An abnormal condition has occurred. The Initiator should issue a REQUEST SENSE command to get further information.

GOOD Status

The requested operation (the last command) was completed successfully.

INTERMEDIATE Status

This status is sent after a successfully completed command in a series of linked commands.

RESERVATION CONFLICT Status

The status is sent to an Initiator that attempts to access the Drive when it is reserved for another Initiator.

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6. Message System

The message system allows communication between an Initiator and the Drive for the purpose of physical path management. The physical path may be broken and reestablished several times during the execution of a SCSI command if the Initiator has granted the Drive the privilege of disconnection.

The first message sent by the Initiator after the SELECTION phase has to be either the IDENTIFY, ABORT TASK SET or TARGET RESET message. The IDENTIFY message may be immediately followed by other messages. The IDENTIFY message establishes the physical path for a particular logical unit specified by the Initiator. Since the Drive has only one logical unit, the specified logical unit number should always be zero. The IDENTIFY message may also grant the Drive disconnection privilege. If the Drive is allowed to disconnect, it may do so by transferring a DISCONNECT message and then release the SCSI-bus (by entering the BUS FREE phase).

The Drive will always at some later stage reestablish the physical path by reselecting the Initiator. After the RESELECTION phase, the Drive's first message will be IDENTIFY. This allows the physical path to be reestablished for the Drive's specified logical unit number.

Whenever a physical path to an Initiator that is utilizing disconnection and reconnection is established, the Initiator must ensure that the active pointers of the physical path are equal to the saved pointers for that particular logical unit number (an implied restore operation should occur as a result of a reselection).

When the Drive has completed the execution of a SCSI command (successfully or not) it will signal the Initiator that it is about to break the physical path for good (for this selection sequence) by transferring a TASK COMPLETE message. The Drive will then enter the BUS FREE phase.

6.1. Message In

The Drive supports the Message-In Bytes shown in the table below:

Message Name	Input/Output	Hex Code
TASK COMPLETE	I	00
DISCONNECT	I	04
EXTENDED MESSAGE	I/O	01
IDENTIFY	I/O	80+
IGNORE WIDE RESIDUE	I	23
LINKED COMMAND COMPLETE	I	0A
LINKED COMMAND COMPLETE W/FLAG	I	0B
MESSAGE REJECT	I/O	07
RESTORE POINTERS	I	03
SAVE DATA POINTER	I	02

Table 6-1: The Message-In Set

TASK COMPLETE

This message will be sent from the Drive to the Initiator to indicate that the execution of a command has terminated. Valid Status will have been sent. This message will always be sent next to a BUSY, CHECK CONDITION, GOOD or RESERVATION CONFLICT status byte. After successfully sending this message, the Drive will enter the BUS FREE phase.

DISCONNECT

This message will be sent from the Drive to the Initiator to inform the Initiator that the Drive is about to disconnect. This message is usually sent second to the SAVE DATA POINTER message. After successfully sending this message, the Drive will enter the BUS FREE phase.

EXTENDED MESSAGE

This message is sent by the Drive to the Initiator as the first byte of a multiple byte message. See Section 6.3 for a description of the extended messages.

IDENTIFY

IDENTIFY will be sent from the Drive to the Initiator immediately after a reconnect (this will be an IDENTIFY with LUN equal to the LUN in the incoming IDENTIFY message (sent during a message-out phase) and with the disconnect privilege bit set to zero, typically code 80h.

LINKED COMMAND COMPLETE

This message will be sent from the Drive to the Initiator to indicate that the execution of a linked command (without the FLAG bit set) has completed. This message will always be sent next to INTERMEDIATE status.

LINKED COMMAND COMPLETE W/FLAG

This message will be sent from the Drive to the Initiator to indicate that the execution of a linked command (with the FLAG bit set) has completed. This message will always be sent next to INTERMEDIATE status.

MESSAGE REJECT

The Drive sends a MESSAGE REJECT message to the Initiator if it receives a message other then the messages listed in the message out table shown below (table 6-2). The Drive also sends a MESSAGE REJECT message to the Initiator if it receives a MESSAGE REJECT message following phases other than a MESSAGE-IN phase.

RESTORE POINTERS

This message will be sent by the Drive to the Initiator before the Drive attempts a retransfer of Data or a Status Byte.

SAVE DATA POINTER

This message will be sent by the Drive to the Initiator before sending the DISCONNECT message to inform the Initiator that a pointer save operation is advised.

IGNORE WIDE RESIDUE

This two-byte message will be sent by the Drive to the Initiator to indicate that the number of valid data bytes sent during the last REQ/ACK handshake of a DATA IN phase is less than the negotiated transfer width. The message will be sent immediately following the DATA IN phase. The second byte of the message contains the number of invalid data bytes transferred, and will be set to 01h.

6.2. Message Out

The Drive supports the Message-Out Bytes shown in the table below:

Message Name	Input/Output	Hex Code
ABORT TASK SET	O	06
TARGET RESET	O	0C
EXTENDED MESSAGE	I/O	01
IDENTIFY	I/O	80+
INITIATOR DETECTED ERROR	O	05
MESSAGE PARITY ERROR	O	09
MESSAGE REJECT	I/O	07
NO OPERATION	O	08

Table 6-2: The Message-Out Set

ABORT TASK SET

Abort the current operation. The Drive goes to the BUS FREE phase. No Status or ending Message will be sent (see section 6.5 for details on the ABORT TASK SET message handling).

TARGET RESET

Abort the current operation. The Drive goes to the BUS FREE phase. No Status or ending Message will be sent. Possible data in the data buffer will neither be transferred to the Initiator nor written to the tape. Possible pending error conditions will be cleared and reservations are released. This message results in a hard reset, ref. section 3.5.2.

EXTENDED MESSAGE

This message is sent by the Initiator to the Drive as the first byte of a multiple byte message. See Section 6.3 for a description of the extended messages.

IDENTIFY

The IDENTIFY message (see the table below) is sent by the Initiator to the Drive to establish an I T L nexus. It may also grant the privilege of disconnecting.

BIT 7	6	5	4	3	2	1	0
Idfy	DscP	LUN					

Table 6-3: The IDENTIFY Message

Idfy The Identify bit is always set in the IDENTIFY message.

DscP A Disconnect Privilege bit of one specifies that the Initiator has granted the Drive the privilege of disconnecting. A DscP-bit of zero means that the Drive will not disconnect.

LUN The Logical Unit Number field should be set to zero because the Drive supports only Logical Unit 0.

INITIATOR DETECTED ERROR

The Initiator may send this message to the Drive to inform that an error has been detected in the Initiator. The source of the error may either be related to previous activities on the bus or may be internal to the initiator and unrelated to any previous activities on the bus. The drive generally responds to an INITIATOR DETECTED ERROR message by retrying the last phase. (i.e. by first going back to the previous phase and then by transferring the same information once more). See section 7.5 for details about how the drive responds to an INITIATOR DETECTED ERROR message received after a Status- or Data In phase.

MESSAGE PARITY ERROR

The Initiator may send this message to the Drive to inform that the last transferred message had a parity error. If the previous phase was a MESSAGE IN, the Drive will go back to the MESSAGE IN phase and the previous Message byte will be transferred once more. If a MESSAGE PARITY ERROR message is received when no message in has been sent, the Drive goes to the BUS FREE phase.

MESSAGE REJECT

The Initiator may send this message to the Drive to indicate that the last message transferred from the Drive was inappropriate or not implemented (see also section 6.4).

NO OPERATION

This message will simply be ignored.

6.3. Extended Message

A value of one (01h) of the first byte of a message indicates the beginning of a multiple-byte extended message. The minimum number of bytes sent for an extended message is three. The extended message format is shown in the table below.

Byte	Value	Description
0	01h	Extended Message
1	n	Extended Message Length
2	y	Extended Message Code
3 - n+1	x	Extended Message Arguments

Table 6-4: Extended Message Format

The extended message length specifies the length in bytes of the extended message code plus the extended message arguments to follow. Therefore, the total length of the message is equal to the extended message length plus two. A value of zero for the extended message length indicates 256 bytes to follow.

The extended messages supported by the are shown in the table below. The extended messages are described in detail in Sections 6.3.1 and 6.3.2.

Extended Message Code	Description
01h	Synchronous Data Transfer Request
03h	Wide Data Transfer Request

Table 6-5: Supported Extended Message Codes

To comply with the ANSI standard [2] and [5], ***Wide Data Transfer must be negotiated prior to negotiating Synchronous Data Transfer.*** If a Synchronous Data Transfer agreement is in effect, it will be reset to asynchronous mode if the Wide Data Transfer Request is accepted.

If a parity error is detected during a MESSAGE-OUT phase the Drive will consume all the remaining bytes in the message and ask for a re-transfer of the whole message.

If a parity error is detected during a MESSAGE-IN phase the Initiator may signal a parity error by transferring a MESSAGE PARITY message back to the Drive. The Drive responds by transferring the whole message once more.

6.3.1. Wide Data Transfer Request

The Wide Data Transfer Request (WDTR) message exchange establishes an agreement between the Initiator and the Drive on the width of the data path to be used for DATA phase transfers between the two devices. The agreement applies to DATA IN and DATA OUT phases only. All other information phases will use an eight-bit data path.

A WDTR message exchange is initiated by the Initiator whenever a previously arranged transfer width agreement may have become invalid, or whenever it is appropriate to negotiate a new transfer width agreement. Re-negotiation at every selection is not recommended, since a significant performance impact is likely.

The agreement becomes invalid after a reset condition.

The Initiator sets its transfer width to the maximum data path width it elects to accommodate. If the Drive can also accommodate this transfer width, it returns the same value in its WDTR message. If it requires a smaller transfer width, it substitutes the smaller value in its WDTR message. The successful completion of an exchange of WDTR messages implies an agreement as follows:

WDTR Response:	Implied agreement:
1) Non-zero transfer width	Each device transmits and receives data with the specified transfer width.
2) Transfer width equal to zero	Eight-bit data transfer
3) MESSAGE REJECT message	Eight-bit data transfer

If the initiator recognizes that negotiation is required, it asserts the ATN signal and sends a WDTR message to begin the negotiating process. After successfully completing the MESSAGE OUT phase, the Drive responds with the proper WDTR message. If an abnormal condition prevents the Drive from returning an appropriate response, both devices shall go to eight-bit data transfer mode for data transfers between the two devices.

Following Drive response (1) above, the implied agreement for wide data transfers is considered to be negated if the initiator asserts ATN and the first message out is either MESSAGE PARITY ERROR or MESSAGE REJECT. In this case, both devices shall go to eight-bit data transfer mode for data transfers between the two devices. For the MESSAGE PARITY ERROR case, the implied agreement shall be reinstated if a re-transmittal of the second of the pair of messages is successfully accomplished. After a specific number of retry attempts, if the Drive receives a MESSAGE PARITY ERROR message, it will terminate the retry activity, and both devices shall go to eight-bit data transfer mode for data transfers between the two devices. The number of retry attempts is specified in the Bus Parity Error Retries field in the Miscellaneous Page of the Mode Select command. Please refer to section 14.3.9 for further details.

The implied transfer width agreement shall remain in effect until a TARGET RESET message is received, until a hard reset condition occurs, or until the Initiator

elects to modify the agreement. The default data transfer width is eight-bit data transfer mode.

The Wide Data Transfer Request Message has the following format:

Byte	Value	Description
0	01h	Extended Message
1	02h	Extended Message Length
2	03h	Wide Data Transfer Request Code
3	m	Transfer Width Exponent

Table 6-6: Wide Data Transfer Request

Transfer Width Exponent

Valid transfer widths are 8 bits (m=00h) and 16 bits (m=01h).

6.3.2. Synchronous Data Transfer Request Message

Synchronous Data Transfer Request (SDTR) message exchange can be initiated by the Initiator to change the data transfer agreement. The default data transfer mode is asynchronous data transfer mode.

An Initiator may initiate an SDTR message whenever it is appropriate to negotiate a new data transfer agreement (either synchronous or asynchronous). The Drive will never respond to an SDTR message with a MESSAGE REJECT message. Re-negotiation at every selection is not re-commended, since a significant performance impact is likely.

The Synchronous Data Transfer Request Message has the following format:

Byte	Value	Description
0	01h	Extended Message
1	03h	Extended Message Length
2	01h	Synchronous Data Transfer Request Code
3	m	Transfer Period (multiples of 4 ns)
4	x	REQ/ACK Offset

Table 6-7: Synchronous Data Transfer Request

Transfer Period

The Transfer Period is the minimum time allowed between leading edges of successive REQ pulses and of successive ACK pulses, set by the device specifications for successful reception of data.

The minimum transfer period is 50 nanoseconds, m = 0Ch (12). The maximum transfer period is 544 nano seconds, m = 88h (136).

When a synchronous data transfer period of less than 200 ns is negotiated, “ fast synchronous data transfer” is used. This will result in different values for some SCSI-bus Timing Values, see [2] and [5].

When a synchronous data transfer period of less than 100 ns is negotiated, Ultra SCSI (Fast-20) data transfer is used. This will result in different values for some SCSI-bus Timing Values, see [18].

REQ/ACK Offset

The REQ/ACK Offset is the maximum number of REQ pulses allowed to be outstanding before the corresponding ACK pulse is received at the Drive. The value is limited by the size of the device's reception buffer. A REQ/ACK off- set of zero indicates asynchronous data transfer mode. The maximum REQ/ACK offset of the Drive is 15.

The default transfer mode is entered at power on, after a TARGET RESET message or a hard reset condition.

The Initiator sets its values to permit it to receive data successfully. If the Drive can also receive data successfully with these values (or smaller transfer periods or larger REQ/ACK offsets or both), it returns the same values in its SDTR message. If it requires a larger transfer period, a smaller REQ/ACK offset, or both in order to receive data successfully, it substitutes values in its SDTR message as required, returning unchanged any value not required to be changed.

The successful completion of an exchange of SDTR messages implies an agreement as follows:

Responding Device SDTR response:	Implied Agreement:
1) Non-zero REQ/ACK offset	Each device transmits data with a transfer period equal to or greater than and a REQ/ACK offset equal to or less than the values received in the other device's SDTR message.
2) REQ/ACK offset equal to zero	Asynchronous transfer
3) MESSAGE REJECT message	Asynchronous transfer

If the initiator recognizes that negotiation is required, it asserts the ATN signal and sends a SDTR message to begin the negotiating process. After successfully completing the MESSAGE OUT phase, the Drive will respond with the proper SDTR message. If an abnormal condition prevents the Drive from returning an appropriate response, both devices shall go to asynchronous data transfer mode for data transfers between the two devices.

Following Drive response (1) above, the implied agreement for synchronous operation is considered to be negated if the initiator asserts the ATN signal and the first message out is either MESSAGE PARITY ERROR or MESSAGE REJECT. In this case, both devices shall go to asynchronous data transfer mode for data transfers between the two devices. For the MESSAGE PARITY ERROR case, the implied agreement shall be reinstated if a re-transmittal of the second of the pair of messages is successfully accomplished. After a specific number of retry attempts, if the Drive receives a MESSAGE PARITY ERROR message, it will terminate the retry activity, and both devices shall go to asynchronous data transfer mode for data transfers between the two devices. The number of retry attempts is specified in the Bus Parity Error Retries field in the Miscellaneous Page of the Mode Select command. Please refer to section 14.3.9 for further details.

The implied synchronous agreement shall remain in effect until a TARGET RESET message is received, until a hard reset condition occurs, or until the Initiator elects to modify the agreement.

6.4. Message Reject Message Handling

This section specifies the use of the MESSAGE REJECT message in both message-in and message-out phases.

6.4.1. Message-In Phase

The drive sends a MESSAGE REJECT message in the following instances:

- When an unsupported message has been received from the Initiator. Supported messages are shown in table 6-2.
- When a MESSAGE REJECT message has been received after a phase that was not a message-in phase.

6.4.2. Message-Out Phase

If, after a MESSAGE-IN phase, the Initiator asserts ATN and transfers a REJECT message, the Drive will react as shown in the table below:

Last Message-In	Action Taken
DISCONNECT	The Drive will not disconnect any more until an IDENTIFY message with the Disconnect Privilege bit set to one is received.
IDENTIFY	The current command is terminated and the drive goes to BUS FREE.
IGNORE WIDE RESIDUE	The reject is ignored and the current command continues execution.
LINKED COMMAND COMPLETE	The current command is terminated and the drive goes to BUS FREE.
LINKED COMMAND COMPLETE W/FLAG	The current command is terminated and the drive goes to BUS FREE.
MESSAGE REJECT	The reject is ignored and the current command continues execution.
SAVE DATA POINTER	Same as for a DISCONNECT message.
SYNCHRONOUS DATA TRANSFER REQUEST	The Drive goes back to asynchronous data transfer.
TASK COMPLETE	Ignore the REJECT message (the drive goes to BUS FREE).
WIDE DATA TRANSFER REQUEST	The Drive goes back to 8-bit data transfer.

Table 6-8: Response to MESSAGE REJECT

If the MESSAGE REJECT message is sent following phases other than MESSAGE-IN, the Drive will respond by sending a MESSAGE REJECT message.

6.5. Abort Message Handling

If the Initiator transfers an ABORT TASK SET message during the MESSAGE IN phase, the Drive will immediately go to the BUS FREE phase. No Status or ending Message will be sent. The Drive will remain in its current state (MODE settings and current tape position must be kept).

When receiving a new command, the Drive will be able to continue where that last aborted command left off.

See Section *4.6. Multiple Connections* for a description of ABORT TASK SET in overlapped command situations.

See also section *3.5.1. Attention (ATN)* for details on ATN signal handling. The following is true for all commands:

- *If the ABORT TASK SET message is transferred before the Drive enters the Command phase, then the Drive will just go to the BUS FREE phase, effectively ignoring the whole selection.*

- *If the ABORT TASK SET message is transferred immediately after the Command phase (ATN must be asserted during command transfer), then the Drive will just go to the BUS FREE phase, effectively ignoring the whole command. This is true even if the Drive detects errors in the command block (like Bus Parity Error).*

- *If the ABORT TASK SET message is transferred immediately after the Status phase the command will have been executed and the Drive will go to the BUS FREE phase*

The table on the following page describes ABORT TASK SET- for all commands when the ABORT TASK SET-message is transferred at any later stage in the phase sequencing.

Command	Action
ERASE LOAD/UNLOAD REWIND	These commands continue to execute as if executed in Immediate (or buffered) mode.
WRITE FILEMARK	When the WRITE FILEMARK command is aborted after disconnection, it has already been executed.
INQUIRY LOG SENSE MODE SENSE READ BLOCK LIMITS READ POSITION REQUEST BLOCK ADDRESS REQUEST SENSE	① If the ABORT TASK SET message is received before the parameter data is transferred, transfer is suppressed. ② Note that for the REQUEST SENSE command the parameter data is usually lost. The other commands may be executed again to get the parameter data once more.
MODE SELECT	The actual mode selection will not be performed if the command is aborted immediately after the parameter data transfer (ATN must be asserted during the data transfer). If the command is aborted in any later phase, the mode selection will, however, already have been performed.
PREVENT/ALLOW MEDIA REMOVAL RELEASE RESERVE TEST UNIT READY	These commands will be executed (the ABORT TASK SET came too late).
READ	If the command is aborted immediately after a data transfer (ATN must be asserted *during* the data transfer), the next Read operation will start on the following block. The Initiator may request sense information (Block Counter) to check the actual number of blocks read.
READ BUFFER	This command will be aborted after the last data transfer. The command may be issued again to retransfer the last transferred data and also the data not transferred when the command was aborted.
LOCATE	The actual seek operation will not be performed if the command is aborted immediately after the parameter data transfer (ATN must be asserted *during* the data transfer). If the command is aborted in any later phase, the seek operation will execute as if the command was executed in immediate mode.
SEND DIAGNOSTICS	The actual diagnostic operation will not be performed if the command is aborted immediately after the parameter data transfer (ATN must be asserted *during* the data transfer). If the command is aborted later, the diagnostic operation has, however, already been performed.
SPACE	The space operation will be terminated immediately. Note however, that if the Drive does not disconnect and ATN is asserted some time after the command phase, the complete space operation will usually have completed before the Drive tests the ATN line (the Drive tests for ATN only when changing bus phases). The Initiator may request sense information (Block Counter) to check the actual number of spaced blocks.
VERIFY (Not supported by SLR7 and SLR140)	If the command is aborted immediately after a data transfer (ATN must be asserted *during* the data transfer), the next Compare operation will start on the following block. The Initiator may request sense information (Block Counter) to check the actual number of compared blocks.
WRITE	If the command is aborted immediately after a data transfer (ATN must be asserted *during* the data transfer), data in the last transfer will not be written on tape. If the last block continues over several transfers, then this complete block will not be written on tape.
WRITE BUFFER	This command will be aborted after the last data transfer. The transferred data has already been written into the data buffer.

Table 6-9: ABORT TASK SET Message Handling

6.6. Unexpected Bus Free

An unexpected bus free occurs when the Initiator detects a BUS FREE condition any time the Initiator does not expect a BUS FREE condition. The drive uses an unexpected bus free to inform the Initiator of a protocol error. The Drive terminates the current command before going to the BUS FREE phase.

The Drive uses an unexpected bus free in the following cases:

- When the first message sent by the Initiator after a successful selection is not an IDENTIFY, ABORT TASK SET or TARGET RESET message.
- When a MESSAGE PARITY ERROR message has been received and the previous phase was not a message-in phase.
- When a second IDENTIFY message with a LUN field value different from the value in the initial IDENTIFY message has been received in the same connection.
- When the Initiator rejects the IDENTIFY message sent by the Drive during a reconnection.
- When a LINKED COMMAND COMPLETE or a LINKED COMMAND COMPLETE W/FLAG message has been rejected.
- When a RESTORE POINTER message has been rejected.
- When a fatal internal error has been detected.

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7. General Exception Handling

7.1. Error Codes

When an error condition is detected in the Drive, this error condition will result in generation of an internal Error Code. The different Error Codes have been given descriptive names. When generating Sense Data the Error Code will be used to generate all other sense related codes, keys and bits (the FMK, EOM and ILI bits, the Sense Key and the Additional Sense Code and Additional Sense Code Qualifier).

The table on the following pages maps Error Codes to various error indicators found in the REQUEST SENSE Data List and is used in the following way:

How to interpret the Error Code Table

If you, for example, seek information about a ***"Filemark Detected"*** *-error, look it up in the alphabetical* ***"Name"*** *-column. The other columns shows the sense data generated for this error condition. For more details about the* ***"SK" = "Sense Key"*** *and* ***"AS/AQ" = "Additional Sense Code and Qualifier"*** *-columns, see Sections 23.4 and 23.5 (under the Request Sense command). Section 23.5 has the error code table sorted on AS/AQ.*

Name	AS	AQ	SK	FMK	EOM	ILI	ERAC
FILEMARK DETECTED	00h	01h	0h	■			5

As you can see, the sense data will have the FMK bit set to one while the EOM and ILI bits will be set to zero. The Sense Key (SK) will be set to 0h. The Additional Sense Code will be set to 00h and the Additional Sense Code Qualifier will be set to 01h.

Error code table sorted by name.
The same table sorted by AS/AQ code is located in Section 23.5.

Name	AS	AQ	SK	FMK	EOM	ILI	ERAC
BEGINNING-OF-PARTITION/MEDIUM DETECTED	00h	04h	0h		■		5
CANNOT DECOMPRESS USING THE DECLARED ALGORITHM	11h	0Eh	3h				5
CANNOT FORMAT MEDIUM, INCOMPATIBLE MEDIUM	30h	06h	5h				2
CANNOT READ MEDIUM, INCOMPATIBLE FORMAT	30h	02h	3h				2
CANNOT READ MEDIUM - UNKNOWN FORMAT	30h	01h	3h				2
CARTRIDGE FAULT, BAD CARTRIDGE	52h	00h	3h				2
CARTRIDGE FAULT, REFERENCE BURST SEEK FAILURE	52h	00h	3h				1
CLEANING CARTRIDGE EJECTED	82h	83h	6h				4
CLEANING CARTRIDGE INSTALLED	30h	03h	2h				2
CLEANING FAILURE	30h	07h	3h				2
CLEANING REQUESTED	00h	17h	1h				1
COMMAND SEQUENCE ERROR	2Ch	00h	5h				5
DATA EXPANSION OCCURRED DURING COMPRESSION	0Ch	05h	1h				5
DECOMPRESSION CRC ERROR	11h	0Dh	3h				5
DIAGNOSTIC FAILURE IN SELFTEST N[1]	40h	nnh[2]	4h				6
DIAGNOSTIC FAILURE, BUFFER PARITY ERROR	40h	80h	4h				3
DIAGNOSTIC FAILURE, WRITE CHIP ERROR	40h	81h	4h				6
DIAGNOSTIC FAILURE, MULTIPLE ERRORS	40h	A0h	4h				6
END-OF-DATA DETECTED	00h	05h	8h				5
END-OF-DATA DETECTED AFTER LEW	00h	05h	8h		■		5
END-OF-PARTITION/MEDIUM DETECTED ON READ, PHYSICAL END REACHED	00h	02h	3h		■		5
END-OF-PARTITION/MEDIUM DETECTED ON WRITE, LEW PASSED	00h	02h	0h		■		0
END-OF-PARTITION/MEDIUM DETECTED ON WRITE, PHYSICAL END REACHED	00h	02h	Dh		■		0
ERASE FAILURE	51h	00h	3h				3
EXCESSIVE WRITE ERRORS	03h	02h	3h				1
EXCESSIVE WRITE ERRORS (SERVO)	03h	02h	3h				2
FILEMARK DETECTED	00h	01h	0h	■			5
INCOMPATIBLE MEDIUM INSTALLED	30h	00h	5h				2
INITIATOR DETECTED ERROR MESSAGE RECEIVED	48h	00h	Bh				5
INTERNAL TARGET FAILURE	44h	00h	4h				6
INVALID BITS IN IDENTIFY MESSAGE	3Dh	00h	5h				5
INVALID COMMAND OPERATION CODE	20h	00h	5h				5
INVALID FIELD IN CDB	24h	00h	5h				5
INVALID FIELD IN PARAMETER LIST	26h	00h	5h				5
LOG COUNTER AT MAXIMUM	5Bh	02h	1h				4

Table 7-1: Error Codes (to be continued…)

[1] N is a number in the range 1 to 40 inclusive.
[2] nn is a hex number in the range A1h to C8h inclusive. A1h corresponds to a diagnostic failure in selftest 1, A2h corresponds to a diagnostic failure in selftest 2 and so on up to C8h which corresponds to a diagnostic failure in selftest 40.

Name	AS	AQ	SK	FMK	EOM	ILI	ERAC
LOG PARAMETERS CHANGED	2Ah	02h	6h				4
LOGICAL UNIT IS IN THE PROCESS OF BECOMMING READY	04h	01h	2h				4
LOGICAL UNIT NOT READY, CAUSE NOT REPORTABLE	04h	00h	2h				5
LOGICAL UNIT NOT READY, INITIALIZING COMMAND REQUIRED	04h	02h	2h				5
LOGICAL UNIT NOT SUPPORTED	25h	00h	5h				5
MECHANICAL POSITIONING ERROR, ILLEGAL HEAD POSITION	15h	01h	3h				2
MEDIA LOAD OR EJECT FAILED	53h	00h	Bh				2
MEDIUM NOT PRESENT	3Ah	00h	2h				2
MEDIUM REMOVAL PREVENTED	53h	02h	2h				5
MESSAGE ERROR	43h	00h	5h				5
MICROCODE HAS BEEN CHANGED	3Fh	01h	6h				4
MISCOMPARE DURING VERIFY OPERATION	1Dh	00h	Eh				0
MODE PARAMETERS CHANGED	2Ah	01h	6h				4
NO ADDITIONAL SENSE INFORMATION, ILLEGAL LENGTH BLOCK READ	00h	00h	0h			■	5
NOT READY TO READY TRANSITION, MEDIUM MAY HAVE CHANGED	28h	00h	6h				4
OVERLAPPED COMMANDS ATTEMPTED	4Eh	00h	Bh				5
PARAMETER LIST LENGTH ERROR	1Ah	00h	5h				5
PERMANENT WRITE PROTECTED (CARTRIDGE END OF LIFE)	27h	05h	7h				2
POWER ON / RESET OCCURRED	29h	00h	6h				4
READ RETRIES EXHAUSTED	11h	01h	3h				1
RECORDED ENTITY NOT FOUND	14h	00h	8h				5
SCSI PARITY ERROR	47h	00h	Bh				4
SETMARK DETECTED	00h	03h	0h	■			5
THRESHOLD CONDITION MET	5Bh	01h	6h				4
TRACK FOLLOWING ERROR	09h	00h	3h				2
TRACKING SERVO FAILURE	09h	01h	4h				6
UNRECOVERED READ ERROR	11h	00h	3h				1
WRITE APPEND ERROR	50h	00h	5h				5
WRITE APPEND POSITION ERROR	50h	01h	3h				1
WRITE PROTECTED	27h	00h	7h				4

Table 7-1: Error Codes

Name	The name of the error condition
ERAC	The Error Recovery Action Code for this error condition. See section 7.8 for further details.
FMK	Shows a ■ if the Filemark bit (FMK) is set to one in the REQUEST SENSE parameter list
EOM	Shows a ■ if the End of Media bit (EOM) is set to one in the REQUEST SENSE parameter list
ILI	Shows a ■ if the Illegal Length bit (ILI) is set to one in the REQUEST SENSE parameter list
SK	Sense Key value in the REQUEST SENSE parameter list
AS	Additional Sense Code in the REQUEST SENSE parameter list
AQ	Additional Sense Code Qualifier in the REQUEST SENSE parameter list

7.2. Error Conditions for All Commands

When an Initiator accesses the Drive, there are a number of error conditions that may occur regardless of the command the Initiator attempts to issue. This section summarizes all such error conditions. See the separate sections for details. For command specific error conditions, please see the section on *General Exception Handling* for the actual command.

Bus Parity Error

Every command may be terminated with CHECK CONDITION status if a bus parity error is detected in the Command Descriptor Block, data out or message out. See Section 7.5. for details.

BUSY Status

The Drive is busy executing a command.

The command can be accepted, but it can not be executed yet since the Drive is busy.

Three different BUSY situations may occur:

1) The drive is already executing a command from another initiator and the new command can't be executed in parallel.

2) The Drive is executing an Immediate-type command (from any initiator) and the BSYI-option is turned on (refer the Miscellaneous Parameters Page in the MODE SELECT command). This condition will prevail until the Immediate-type command has completed its execution (or the BSYI-option is turned off).

3) The drive is occupied by a drive-initiated preparation activity (as e.g. Autoload) and the BSYA-option is turned on (refer the Miscellaneous Parameters Page in the MODE SELECT command). This condition will prevail until the drive-initiated activity has completed (or the BSYA-option is turned off).

Invalid Command Operation Code

If the Command Operation Code (byte 0 of the CDB) is not in the range of supported Command Operation Codes, the command will then be terminated with CHECK CONDITION Status. The Error Code will be set to INVALID COMMAND OPERATION CODE.

Message Parity Error Message

Every command may be terminated if a MESSAGE PARITY ERROR message is received. The Error Code will be set to SCSI PARITY ERROR.

See section 7.5. for details.

Overlapped Commands

If an Initiator issues a new command while it still has a command under execution by the Drive, the first command is aborted and the new command is terminated with CHECK CONDITION. The Error Code will be set to OVERLAPPED COMMANDS ATTEMPTED.

See section 4.6 for details.

Reservation Conflict

Every command except INQUIRY, REQUEST SENSE and RELEASE will be terminated with RESERVATION CONFLICT status if the Drive has been reserved for another Initiator.

See the RESERVE and RELEASE commands for details.

Reserved Field

Every command will be terminated with CHECK CONDITION if one or more reserved bit, field, or byte is not zero. The Error Code will be set to INVALID FIELD IN CDB or INVALID FIELD IN PARAMETER LIST.

Unit Attention

Each command except INQUIRY and REQUEST SENSE will be terminated with CHECK CONDITION status due to a Unit Attention Condition.

The Error Codes are:

CLEANING CARTRIDGE EJECTED
LOG PARAMETERS CHANGED
MICROCODE HAS BEEN CHANGED
MODE PARAMETERS CHANGED
NOT READY TO READY TRANSITION, MEDIUM MAY HAVE CHANGED
POWER ON / RESET OCCURRED
SCSI-BUS RESET OCCURRED
THRESHOLD CONDITION MET

Unsupported LUN

The Drive supports only Logical Unit 0. The LUN field in the Command Descriptor Block and the IDENTIFY message must always be set to zero. All commands except INQUIRY and REQUEST SENSE will terminate with CHECK CONDITION if the LUN field is not set to zero. The Error Code will be set to LOGICAL UNIT NOT SUPPORTED.

7.3. Deferred Errors

A deferred error is an error that occurs on an Immediate or Buffered type command after that command has terminated with GOOD status and before the next command has started execution. If the error occurs after the next command has started execution, the error will be reported as a normal non-deferred error for that command.

All commands except INQUIRY and REQUEST SENSE may be terminated due to deferred errors.

When a Deferred Error has been detected in the Drive, the first Initiator to access the Drive will have its command terminated with CHECK CONDITION even if this Initiator is different from the Initiator that issued the command that failed. To avoid this situation an Initiator may use the RESERVE command to have exclusive access and then the WRITE FILEMARKS (with filemark count equal to zero if necessary) to synchronize with the Drive before letting other Initiators access the Drive again.

Note:
The VADD bit will not be set and the Information Bytes will not be valid when a Deferred Error has been detected.

Append Failure

The Drive was not able to append new data to data already existing on the tape. This is a fatal error. Unwritten data and filemarks may be left in the data buffer. See also the section on *General Exception Handling* for the WRITE and WRITE FILEMARKS commands. The Error Code will be set to WRITE APPEND POSITION ERROR

Buffer Parity Error

All commands transferring data to or from the data buffer will be terminated with CHECK CONDITION if a buffer parity error is detected. See section 7.6. for details

Cartridge Error

See section on *Error Conditions For Media Access Commands*

Head Servo Error

See section on *Error Conditions For Media Access Commands*

No Cartridge

See section on *Error Conditions For Media Access Commands*

Non-Recoverable Write Error

A non-recoverable write error has occurred while writing data or filemarks. This is a fatal error. Unwritten data and filemarks may be left in the data buffer. See also the section on *General Exception Handling* for the WRITE and WRITE FILEMARKS commands. The Error Code will be set to EXCESSIVE WRITE ERRORS.

Sensor Error

See section on *Error Conditions For Media Access Commands*

Tape Runout

See section on *Error Conditions For Media Access Commands*

Write LEW

The Logical Early Warning (LEW) tape marker has been encountered

while writing data or filemarks. This indicates that the tape cartridge is full. The Error Code will be set to END-OF-PARTITION/MEDIUM DETECTED ON WRITE, LEW PASSED

Write EOM

The physical end of partition has been encountered while writing data or filemarks. This is a fatal error. Unwritten data and filemarks may be left in the data buffer. See also the section on *General Exception Handling* for the WRITE and WRITE FILEMARKS commands. The Error Code will be set to END-OF-PARTITION/MEDIUM DETECTED ON WRITE, PHYSICAL END REACHED

7.4. Error Conditions for Media Access Commands

When the Initiator issues one of the Media Access Commands, there are a number of error conditions (in addition to the general error conditions) that may occur. This section summarizes all such error conditions. For command specific error conditions, please see the section on *General Exception Handling* for the actual command.

Cartridge Error

An error has been detected in the Capstan Motor System. Media Access commands will be terminated with CHECK CONDITION status. The Error Code will be set to CARTRIDGE FAULT.

Cartridge Manipulation Error

An error has been detected in the load/eject mechanism. Media Access commands will be terminated with CHECK CONDITION status. The Error Code will be set to MEDIA LOAD OR EJECT FAILED.

No Tape Edge Found

An error has been detected in the Tape Head Serve System. Media Access commands will be terminated with CHECK CONDITION status. The Error Code will be set to CARTRIDGE FAULT.

No Cartridge

No cartridge is inserted or the cartridge was removed during command execution. Media Access commands will be terminated with CHECK CONDITION status. The Error Code will be set to MEDIUM NOT PRESENT or MEDIUM NOT PRESENT, REMOVED DURING COMMAND EXECUTION.

Not Loaded

The cartridge has not been loaded by a LOAD/UNLOAD command or by the AutoLoad function. The Error Code will be set to LOGICAL UNIT NOT READY, INITIALIZING COMMAND REQUIRED (LOAD/UNLOAD with the Load bit set to one) or LOGICAL UNIT IS IN THE PROCESS OF BECOMMING READY (a LOAD/UNLOAD command or AutoLoad is under execution).

Sensor Error

An error has been detected in the Tape Hole Sensor System. Media Access commands will be terminated with CHECK CONDITION status. The Error Code will be set to CARTRIDGE FAULT.

Tape Runout

The tape has run out on one of the cartridge reels. Media Access commands will be terminated with CHECK CONDITION status. The Error Code will be set to CARTRIDGE FAULT.

7.5. Power On Selftest (POST) Error Handling

The Drive executes Power On Selftests (POST) during Power On and microcode download, and may detect failures. How the Drive reacts after detection of a Power On Selftest (POST) error depends on which command the initiator wants to execute. Some commands will be executed as normal, others will be terminated.

The first REQUEST SENSE command issued after Power On will return sense data for UNIT ATTENTION since UNIT ATTENTION has priority over all other errors. The REQUEST SENSE command issued after a command terminated because of POST failure will return sense data for this POST failure. All other REQUEST SENSE commands will return sense data for the command previously executed, normally NO SENSE.

If the Power On SelfTest (POST) sequence reports a failure, the amber LED will flash until a Selftest sequence (i.e. POST or SEND DIAGNOSTICS command) is initiated and successfully executed. The Amber Led will not be cleared by drive Reset. Successful execution of the POST sequence will also clear the POST failure information and all commands will execute as normal again.

7.5.1. Commands Executed After POST Error

The following commands will be executed as normal after detection of a POST error.

- REQUEST SENSE
- INQUIRY
- SEND DIAGNOSTICS
- RECEIVE DIAGNOSTICS

If the command is successfully executed and terminated with OK STATUS, a subsequent REQUEST SENSE command will return NO SENSE.

If the Selftest(s) failing during Power On also is part of the SEND DIAGNOSTICS sequence, this Selftest is expected to fail during the SEND DIAGNOSTICS execution as well, and thus the command will terminate with CHECK CONDITION. A subsequent REQUEST SENSE command will return Sense Data according to the previously detected POST failure.

If the Selftest(s) failing during Power On is not included in an issued SEND DIAGNOSTICS sequence, the SEND DIAGNOSTICS will return OK STATUS if no other errors are detected.

7.5.2. Commands Terminated After POST Error

All commands other then those mentioned in 7.5.1. issued after detection of a POST error will be terminated with CHECK CONDITION each time (not only the first time!) they are issued. A subsequent REQUEST SENSE command will return sense data according to the last failed Selftest in the POST sequence.

7.6. Bus Parity Error Handling

The Drive checks the state of the Bus Parity Error Jumper during Power- Up/Reset initialization. Depending on the state of this jumper, bus parity error checking is either globally enabled or disabled.

The Drive supports re-transfer of commands, status, data and messages.

When bus parity error checking is enabled, the Drive will check for bus parity errors during transfer of Command Descriptor Blocks, Data Out and Message Out. In addition the Drive retries the last phase when an INITIATOR DETECTED ERROR or MESSAGE PARITY error message is received.

The Drive is able to limit the number of retransfer attempts, which will be performed upon continued parity error detection. This number may be configured by the host (using the Bus Parity Error Retries field in the Miscellaneous Page of Mode Select). The retransfer procedures described below will be repeated until the error condition has vanished or the maximum number of retries is reached. If the maximum number of retries is reached, the command will be terminated

If the Bus Parity Error Retry count field has been set to zero, no retries are performed. In this case the command is terminated immediately

Commands terminated either with CHECK CONDITION or an Unexpected Bus Free Condition. In the first case the error code generated will be SCSI PARITY ERROR or INITIATOR DETECTED ERROR MESSAGE RECEIVED.

7.6.1. Errors Detected by the Drive

When a bus parity error has been detected in a SELECTION phase, the selection will be ignored by the Drive.

When detecting a bus parity error in the COMMAND, DATA OUT or MESSAGE OUT phases the drive may retransfer the command, data burst or the message. If the parity error persists, the drive will repeat the retry operation until the Bus Parity Error Retry count has been exhausted. The Bus Parity Error Retry count is configurable (see the *Bus Parity Error Retry* field in the Miscellaneous Parameters mode page).

When a bus parity error has been detected in the COMMAND phase, the Drive will go to the to MESSAGE IN phase and transfer a RESTORE POINTERS message. The Drive will then go back to the COMMAND phase and the Command Descriptor Block will be transferred once more from the Initiator. When transferring Command Descriptor Blocks, the Drive will stop the transfer immediately when a parity error has been detected. If the parity error persists and the Bus Parity Error Retry count has been exhausted (or if the Bus Parity Error Retry has been configured to 0), the drive will terminate the command with CHECK CONDITION status. The Error Code will be SCSI PARITY ERROR.

When a bus parity error has been detected in a DATA OUT phase, the Drive will go to the MESSAGE IN phase and transfer a RESTORE POINTERS message. The Drive will then go back to the DATA OUT phase and the data transferred since the last reconnect (or COMMAND phase) will be transferred once more from the Initiator. When transferring Data Out, the Drive will transfer a complete burst before taking any action on bus parity errors. When a bus parity error has been detected, the Drive will ensure that the erroneous burst is not written to the tape. If the parity error persists and the Bus Parity Error Retry count has been exhausted (or if the Bus Parity Error Retry has been configured to 0), the drive will terminate the command with CHECK CONDITION status. The Error Code will be SCSI PARITY ERROR. If the erroneous burst is a part of a large block (split in several transfers), then the complete block will not be written on tape.

If a parity error is detected during a MESSAGE OUT phase, the Target will consume all the remaining bytes in the message and ask for re-transfer of the whole message. If the parity error persists and the Bus Parity Error Retry count has been exhausted (or if the Bus Parity Error Retry has been configured to 0), the drive will go to the BUS FREE phase (creating an Unexpected Bus Free condition).

If ATN is deasserted before the expected number of bytes is transferred, the Target will send a REJECT MESSAGE back to the Initiator.

If ATN is still asserted after the expected number of bytes is transferred, the Target goes to the BUS FREE state.

7.6.2. Errors Detected by the Initiator

The Initiator signals bus parity errors by asserting ATN. The Drive must acknowledge the ATN by going to the MESSAGE OUT Phase. The MESSAGE OUT transferred will be either an INITIATOR DETECTED ERROR message or a MESSAGE PARITY ERROR message.

When receiving an INITIATOR DETECTED ERROR message or a MESSAGE PARITY ERROR message the drive may retry the last phase (the one immediately before the MESSAGE OUT phase). If the Initiator keeps on asserting ATN and responding with one of the two above mentioned messages, the drive will repeat the retry operation until the Bus Parity Error Retry count has been exhausted. The Bus Parity Error Retry count is configurable (see the *Bus Parity Error Retry* field in the Miscellaneous Parameters mode page). It can be set to zero. In this case there will be no retries and the command will be terminated immediately.

If the previous phase was a DATA IN phase and the last transferred message was INITIATOR DETECTED ERROR, then the Drive will go to the MESSAGE IN phase and transfer a RESTORE POINTERS message. The Drive will then go back to the DATA IN phase and the data transferred since the last reconnect (or COMMAND phase) will be transferred once more to the Initiator. If the Bus Parity Error Retry count gets exhausted (or if the Bus Parity Error Retry has been configured to 0), the drive will terminate the command with CHECK CONDITION status. The Error Code will be INITIATOR DETECTED ERROR MESSAGE RECEIVED.

If the previous phase was a STATUS phase and the last transferred message was INITIATOR DETECTED ERROR, then the Drive will go to the MESSAGE IN phase and transfer a SAVE DATA POINTER message and then a RESTORE POINTERS message. The Drive will then go back to the STATUS phase and the Status byte will be transferred once more to the Initiator. If the Bus Parity Error Retry count gets exhausted (or if the Bus Parity Error Retry has been configured to 0), the drive will go to the BUS FREE phase (creating an Unexpected Bus Free condition).

If the previous phase was a MESSAGE IN phase and the last transferred message was MESSAGE PARITY ERROR, then the Drive will go back to the MESSAGE IN phase and the previous Message byte will be transferred once more. If the Bus Parity Error Retry count gets exhausted (or if the Bus Parity Error Retry has been configured to 0), the drive will go to the BUS FREE phase (creating an Unexpected Bus Free condition).

7.7. Buffer Parity Error Handling

The Drive will check for buffer parity errors when transferring data from the data buffer to the tape. When a buffer parity error has been detected the drive will re-write the data until the parity error goes away or until the Write Retries count has been exhausted.

7.8. Error Priority

The Drive implements the following error reporting priority for different commands. The first element in the table has the highest priority.

Exception	INQUIRY	REQUEST SENSE	Other Commands
Parity Error	CHECK CONDITION	CHECK CONDITION	CHECK CONDITION
Overlapped Commands	CHECK CONDITION	CHECK CONDITION	CHECK CONDITION
Drive Reserved	Execution	Execution (Sense data indicates Reservation Conflict)	CHECK CONDITION
Unit Attention	Execution	Execution (Sense data indicates Unit Attention)	CHECK CONDITION
Deferred Error	Execution	Execution (Sense data indicates cause of deferred error)	CHECK CONDITION (Sense data will indicate cause of deferred error)
Invalid Command Op. Code	CHECK CONDITION	CHECK CONDITION	CHECK CONDITION
Reserved Bits/Fields	CHECK CONDITION	CHECK CONDITION	CHECK CONDITION
Illegal Flag/Link Combination	CHECK CONDITION	CHECK CONDITION	CHECK CONDITION
Unsupported LUN	Execution (Inquiry data indicates Unsupported LUN)	Execution (Sense data indicates Unsupported LUN)	CHECK CONDITION
Other Errors	CHECK CONDITION	CHECK CONDITION	CHECK CONDITION

Table 7-2: Error Priority

When reading or verifying variable blocks, the Drive may signal 'Illegal Length Indication' if the actual length of a block does not match the requested length. When the actual number of data bytes found is less than the number of bytes requested, the Drive usually signals 'Illegal Length Indication' (the Drive error code is set to NO ADDITIONAL SENSE INFORMATION, ILLEGAL LENGTH BLOCK READ and the ILI-bit is set in the Sense Data List). The following error conditions have higher priority than 'Illegal Length Indication', and the actual error is reported instead of 'Illegal Length Indication'.

RECORDED ENTITY NOT FOUND
MEDIUM NOT PRESENT, REMOVED DURING COMMAND EXECUTION
CARTRIDGE FAULT, BAD CARTRIDGE
END-OF-DATA DETECTED[1]
END-OF-DATA DETECTED AFTER LEW[1]
END-OF-PARTITION/MEDIUM DETECTED ON READ, PHYSICAL END REACHED
READ RETRIES EXHAUSTED
CANNOT READ MEDIUM. UNKNOWN FORMAT
DECOMPRESSION CRC ERROR

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[1] This error will only have priority over 'Illegal Length Indication' when it is a real error. This means that if the block preceding the erased tape area is terminated in a normal way, the 'Illegal Length Indication' is reported when a READ/VERIFY command has specified a transfer length larger than the block length. Only when a variable length block has been truncated by some kind of media error (as when the previously written data has been erased) will the 'Logical End Of Partition' error take priority over 'Illegal Length Indication'.

7.9. Suggested Error Recovery Action

For each error code in table 7-1 a *suggested error recovery action code (ERAC)* is listed. The ERAC code is meant to indicate a suitable recovery action to be taken by the Initiator or the system operator when an error has occurred. The different recovery actions are:

0 : No action

1 : Clean drive. Drive needs cleaning. Use a cleaning cartridge.

2 : Try another cartridge. The cartridge is questionable and should be replaced.

3 : Run diagnostics. A possible hardware problem. Execute a SEND DIAGNOSTICS command, a Self-exerciser selftest or run a Diagnostic tape to get more information.

4 : Re-issue command. A temporary condition (for instance a Unit Attention) needs to be cleared.

5 : Re-issue corrected command and/or parameter list. The drive detected an error in the CDB or in a parameter list. A reserved bit or field that is not set to zero or a field value that is out of range typically causes this.

6 : Call service. The drive has detected a hardware problem. To be correct by authorized service personnel.

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8. Erase

8.1. Command Description

When using SLRtape140 to SLRtape7 or SLR32, media the ERASE command causes the Drive to erase one entire partition at the time. The partition can either be erased logically or it can be physically overwritten (depending on the state of the LONG bit). When finished the tape will be positioned at BOP of the current partition. The ERASE command is only accepted if the tape is positioned at BOP of any partition.

The Drive will disconnect during execution of the ERASE command if disconnection is allowed.

None of the drives covered by this manual has the ability to write on older tapes. Therefore no erase can be performed on SLR5 or DC9250 media.

8.2. Command Descriptor Block

BYTE	BIT 7	6	5	4	3	2	1	0
00	Operation Code **19h**							
01	Logical Unit Number (LUN)			RESERVED			IMM	LONG
02	RESERVED							
03	RESERVED							
04	RESERVED							
05	Control Byte							

Table 8-1: ERASE Command Descriptor Block

IMM

An Immediate bit (IMM) of zero indicates that the Drive will not return status until the erase operation has completed. An IMM bit of one indicates that the Drive will return status as soon as the execution of all previous commands has been completed and the Command Descriptor Block of the ERASE command has been validated. If CHECK CONDITION status is returned for the ERASE command with an IMM bit of one, the erase operation is not performed.

LONG

SLRtape140, SLRtape100, SLRtape75, SLRtape60, SLRtape50, SLRtape40, SLRtape7, SLR32 and SLRtape24 media:

When this bit is set to one, the current partition is erased by overwriting from BOP to EOP and updating the device directory indicating that this active partition is erased. The Drive is positioned at BOP of the erased partition.

When the long bit is set to zero the Drive will update the device directory indicating that this active partition is erased. However the physical data will still be on the media. The Drive is positioned at BOP of the erased partition.

After erase the tape still knows about its partitions.

8.3. Exception Handling

See sections on *Error Conditions For All Commands*, *Deferred Errors* and *Error Conditions For Media Access Commands*.

If the ERASE command is received while the inserted tape is not positioned at BOP (or BOM), the Drive will terminate the ERASE command with CHECK CONDITION status. The Error Code will be set to COMMAND SEQUENCE ERROR.

If the IMM and Link bits are both set to one, the Drive will terminate the ERASE command with CHECK CONDITION status. The Error Code will be set to INVALID FIELD IN CDB.

The Drive returns CHECK CONDITION status if the Long bit is not set when SLR5 or DC9250 type media. The Error Code will be set to INVALID FIELD IN CDB.

8.4. Phase Sequencing

In this section the possible SCSI-bus phase sequences during execution of the command are described. Section 3.2 has more details about the generic phases in the brackets.

<sequence 1> := <initiator-part> <message-out> <command> <disconnect> <reconnect> <completed>

The Drive will disconnect when the CDB has been transferred. If the IMM-bit is set, the Drive reconnects before executing the command. If the IMM-bit is not set, the Drive reconnects when the tape is positioned back at BOP (or when an error has been detected).

<sequence 2> := <initiator-part> <message-out> <command> <completed>

This sequence will be used when the ERASE command is executed and

9. Inquiry

9.1. Command Description

The INQUIRY command requests that information regarding parameters of the Drive are to be sent to the Initiator.

The Parameter List is transferred during the DATA-IN phase of the command.

The INQUIRY command will execute even if the Initiator specifies an unsupported LUN

The INQUIRY command will execute normally even if a reservation conflict exists.

The INQUIRY command will execute even if a Unit Attention condition is pending and the INQUIRY command will not clear the Unit Attention condition.

The INQUIRY command will not check for Deferred Errors.

9.2. Command Descriptor Block

BYTE	BIT 7	6	5	4	3	2	1	0
00	Operation Code **12h**							
01	Logical Unit Number (LUN)			RESERVED			CmdDt	EVPD
02	Page Code							
03	RESERVED							
04	Allocation Length							
05	Control Byte							

Table 9-1: INQUIRY Command Descriptor Block

CmdDt The Command Supported Data (CmdDt) bit must be set to zero.

EVPD An Enable Vital Product Data bit of one specifies that the Drive will return the Vital Product Data (VPD) specified by the Page Code field. An EVPD bit of zero specifies that the Drive will return the standard INQUIRY data.

Page Code This field specifies which page of VPD information the Drive will return. This field MUST be set to zero if the EVPD bit is not set to one. Legal values are:

00h : Summary of supported pages
80h : Unit Serial Number Page
81h : Implemented Operating Definition Page
82h : ASCII Implemented Operating Definition Page
C0h : Hardware Revision Levels
C1h : PROM Microcode Revision Level
C2h : Drive Manufacturing Date
C3h : PROM Microcode Creation Date
C4h : Drive Adjustment Date

Allocation Length

This field specifies the maximum number of bytes that the Initiator has allocated for returned INQUIRY data. An Allocation Length of zero indicates that no INQUIRY data will be sent. The Drive terminates the DATA-IN phase when Allocation Length bytes have been transferred or when all available INQUIRY data have been transferred, whichever is less.

9.3. Parameter Lists

9.3.1. Standard Inquiry Data

BYTE	BIT 7	6	5	4	3	2	1	0
00	Peripheral Qualifier			Peripheral Device Type				
01	RMB	*Reserved*						
02	ISO/IEC		ECMA			ANSI		
03	AERC	TrmTsk	NormACA	*Reserved*	Response Data Format			
04	Additional Length							
05	*Reserved*							
06	*Reserved*	EncServ	*Reserved*	MultiP	MChngr	ACKQREQQ	Addr32	Addr16
07	RelA	WB32	WB16	Sync	Link	TranDis	CmdQue	*Reserved*
08	Vendor ID			“T”				
09				“A”				
10				"N"				
11				"D"				
12				"B"				
13				"E"				
14				"R"				
15				"G"				
16	Product ID	“S”	“M”	“S”	“S”	“S”		
17		“L”	“L”	“L”	“L”	“L”		
18		“R”	“R”	“R”	“R”	“R”		
19		“7”	“3”	“6”	“1”	“1”		
20		“ “	“ “	“0“	“0“	“4“		
21		“ “	“ “	“ “	“0“	“0“		
22		“ “	“ “	“ “	“ “	“ “		
23		“ “	“ “	“ “	“ “	“ “		
24		“ “	“ “	“ “	“ “	“ “		
25		“ “	“ “	“ “	“ “	“ “		
26		“ “	“ “	“ “	“ “	“ “		
27		“ “	“ “	“ “	“ “	“ “		
28		“ “	“ “	“ “	“ “	“ “		
29		“ “	“ “	“ “	“ “	“ “		
30		“ “	“ “	“ “	“ “	“ “		
31		“ “	“ “	“ “	“ “	“ “		
32	Main Microcode Revision Level							
33								
34								
35								
36	Main Microcode Release Status							

Table 9-2: INQUIRY Parameter List (to be continued...)

BYTE	BIT 7	6	5	4	3	2	1	0
37 38 39 40	Main Microcode Branch Revision Level							
41 42	Main Microcode ID							
43 44 45 46	DSP Microcode Revision Level							
47	DSP Microcode Release Status							

Table 9-2: INQUIRY Parameter List

Peripheral Qualifier	This field will normally be set to zero. However, when an Unsupported LUN condition exists (if an IDENTIFY message is received, the LUN field in the Command descriptor block will be ignored and only the LUN field in the IDENTIFY message will be evaluated.), this field will be set to 3.
Peripheral Device Type	This field is normally set to 1. When an Unsupported LUN condition exists , this field will , however, be set to 1Fh.
RMB	Removable Medium. This field is always set to 1.
ISO/IEC	ISO/IEC version is always set to zero (ISO compliance is not claimed).
ECMA	ECMA version is always set to zero (ECMA compliance is not claimed).
ANSI	The ANSI version is set to 2 (the Drive complies with ANSI X3.131-1994).
AERC	This bit is set to zero (no Asynchronous Event Reporting Capability).
TrmTsk	This bit is set to zero to indicate that the Drive does not support the TERMINATE TASK message.
NormACA	The Normal ACA Supported bit is set to zero to indicate that Drive does not support setting the NACA bit of the Control Byte to one.
Response Data Format	This field is set to 2 (SCSI-2 Standard Format).
Additional Length	This field specifies the number of additional INQUIRY parameter bytes. This field is always set to 43 (2Bh).
EncServ	The Enclosure Service bit is set to zero indicate that the Drive does not contain an embedded enclosure services component
MultiP	This bit set to zero, to indicate that this device has a single port.
MChngr	This bit is set to zero, to indicate that this device is NOT attached to a medium transport element.
ACKQREQQ	This bit is set to zero, to indicate that the Drive has no ACK or REQ signals on a Q cable.

Addr 32	This bit is set to zero, to indicate that the Drive does NOT supports 32-bits wide SCSI addresses.
Addr 16	This bit is set to one, to indicate that the Drive supports 16-bits wide SCSI addresses.
RelA	This bit is set to zero to indicate that the Drive does not support relative addressing.
WB32	This bit is set to zero to indicate that the Drive does not support 32-bit data transfer.
WB16	This bit is set to one to indicate that the Drive supports 16-bit data transfer.
Sync	This bit is set to one to indicate that the Drive supports synchronous data transfer.
Link	This bit is set to one to indicate that the Drive supports linked commands.
TranDis	This bit is set to zero, to indicate that the Drive does not support the CONTINUE I/O PROCESS or TARGET TRANSFER DISABLE messages.
CmdQue	This bit is set to zero to indicate that the Drive does not support tagged command queuing.
Vendor ID	These bytes hold this ASCII string: "TANDBERG".
Product ID	These bytes hold the ASCII string: SLR140 : "SLR140 " or SLR100 : "SLR100 " or SLR75 : "SLR60 " or SLR60 : "SLR60 " or SLR50 : "MLR3 " or SLR7 : "SLR7 "
Main Microcode Revision Level	Four ASCII characters showing the microcode revision number. The two most significant bytes are incremented by "1" for every major code revision. The two least significant bytes are incremented by 1 each time new code is made.
Main Microcode Release Status	A single ASCII character designating if the microcode was released for the customers or if it is microcode for internal use. "R" : Released Code "D" : Development Code
Main Microcode Branch Revision Level	Four ASCII characters showing the revision number of a branched microcode. The use is the same as described for the Main Microcode Revision Level field above.
Main Microcode ID	Two ASCII characters designating custom version of the microcode.
DSP Microcode Revision Level	Four ASCII characters showing the DSP microcode revision number. The two most significant bytes are incremented by "1" for every major code revision. The two least significant bytes are incremented by 1 each time new code is made.
DSP Microcode Release Status	A single ASCII character designating if the DSP microcode was released for the customers or if it is microcode for internal use. "R" : Released Code "D" : Development Code

9.3.2. Vital Product Data

9.3.2.1. Summary of Supported Pages

BYTE	BIT 7	6	5	4	3	2	1	0
00	Peripheral Qualifier			Peripheral Device Type				
01	Page Code = 00h							
02	RESERVED							
03	Page Length = 09h							
04	Supported Page = 00h							
05	Supported Page = 80h							
06	Supported Page = 81h							
07	Supported Page = 82h							
08	Supported Page = C0h							
09	Supported Page = C1h							
10	Supported Page = C2h							
11	Supported Page = C3h							
12	Supported Page = C4h							

Table 9-3: Summary of Supported VPD Pages

Peripheral Qualifier This field will normally be set to zero. When an Unsupported LUN condition exists (if an IDENTIFY message is received, the LUN field in the Command descriptor block will be ignored and only the LUN field in the IDENTIFY message will be evaluated.), this field will, however, be set to 3.

Peripheral Device Type This field is normally set to 1. When an Unsupported LUN condition exists , this field will, however, be set to 1Fh.

Page Code This field will be set to the value of the Page Code field in the Command Descriptor Block.

Page Length This field specifies the length in bytes of the parameters that follow the Page Length field.

Supported Page This is a list of the pages supported by the Drive.

9.3.2.2. Unit Serial Number

BYTE	BIT 7	6	5	4	3	2	1	0
00	Peripheral Qualifier			Peripheral Device Type				
01	Page Code = 80h							
02	RESERVED							
03	Page Length = 0Ch							
04 05 06 07 08 09 10 11 12 13 14	Unit Serial Number							
15	End of String = 00h							

Table 9-4: Unit Serial Number Page

Peripheral Qualifier This field will normally be set to zero. When an Unsupported LUN condition exists (If an IDENTIFY message is received, the LUN field in the Command descriptor block will be ignored and only the LUN field in the IDENTIFY message will be evaluated.), this field will, however, be set to 3.

Peripheral Device Type This field is normally set to 1. When an Unsupported LUN condition exists , this field will, however, be set to 1Fh.

Page Code This field will be set to the value of the Page Code field in the Command Descriptor Block.

Page Length This field specifies the length in bytes of the parameters that follow the Page Length field.

Unit Serial Number This is the unit serial number represented with 11 ASCII characters. The string is terminated with a zero (00h) character.

9.3.2.3. Implemented Operating Definitions

BYTE	BIT 7	6	5	4	3	2	1	0
00	Peripheral Qualifier			Peripheral Device Type				
01	Page Code = 81h							
02	RESERVED							
03	Page Length = 02h							
04	R	Current Operating Definition						
05	SavImp	Default Operating Definition						

Table 9-5: Implemented Operating Definitions Page

Peripheral Qualifier This field will normally be set to zero. When an Unsupported LUN condition exists (if an IDENTIFY message is received, the LUN field in the Command descriptor block will be ignored and only the LUN field in the IDENTIFY message will be evaluated.), this field will, however, be set to 3.

Peripheral Device Type This field is normally set to 1. When an Unsupported LUN condition exists , this field will, however, be set to 1Fh.

Page Code This field will be set to the value of the Page Code field in the Command Descriptor Block.

Page Length This field specifies the length in bytes of the parameters that follow the Page Length field.

Current Operating Definition This field is set to 03h to indicate that the Drive implements the SCSI-2 X3.131-1994 Operating Definition.

SavImp This bit is set to zero, to indicate that the operating definition parameter can not be saved.

Default Operating Definition This field is set to 03h to indicate that the Drive implements the SCSI-2 X3.131-1994 Operating Definition.

9.3.2.4. ASCII Implemented Operating Definition

BYTE	BIT 7	6	5	4	3	2	1	0
00	Peripheral Qualifier			Peripheral Device Type				
01	Page Code = 82h							
02	RESERVED							
03	Page Length = 14h							
04	ASCII Operation Definition Description Length = 13h							
05	ASCII Operating Definition "S"							
06	"C"							
07	"S"							
08	"I"							
09	"-"							
10	"2"							
11	" "							
12	"X"							
13	"3"							
14	"."							
15	"1"							
16	"3"							
17	"1"							
18	"-"							
19	"1"							
20	"9"							
21	"9"							
22	"4"							
23	End Of String = 00h							

Table 9-6: ASCII Implemented Operating Definition Page

Peripheral Qualifier This field will normally be set to zero. When an Unsupported LUN condition exists (if an IDENTIFY message is received, the LUN field in the Command descriptor block will be ignored and only the LUN field in the IDENTIFY message will be evaluated.), this field will, however, be set to 3.

Peripheral Device Type This field is normally set to 1. When an Unsupported LUN condition exists , this field will, however, be set to 1Fh.

Page Code This field will be set to the value of the Page Code field in the Command Descriptor Block.

Page Length This field specifies the length in bytes of the parameters that follow the Page Length field.

ASCII Operating Definition Description Length This field specifies the length in bytes of the Following ASCII string (trailing 00h character included).

ASCII Operating Definition This field holds the string " SCSI-2 X3.131-1994" .

9.3.2.5. Hardware Revision Levels

BYTE	BIT 7	6	5	4	3	2	1	0
00	Peripheral Qualifier			Peripheral Device Type				
01	Page Code = C0h							
02	RESERVED							
03	Page Length = 17h							
04 05	Capstan Motor Assembly Revision Level							
06 07	Step Motor Assembly Revision Level							
08 09	Cartridge Manipulation Motor Module Revision Level							
10 11	Sensor Assembly Revision Level							
12 13	Mainboard Assembly Revision Level							
14 15	Frame Module Revision Level							
16 17	Head Assembly Revision Level							
18 19	Top Cover Module Revision Level							
20 21	Bridge Module Revision Level							
22 23	Bridge Revision Level							
24 25	Main Spring Module Revision Level							
26	End Of String = 00h							

Table 9-7: Hardware Revision Levels Page

Peripheral Qualifier This field will normally be set to zero. When an Unsupported LUN condition exists (if an IDENTIFY message is received, the LUN field in the Command descriptor block will be ignored and only the LUN field in the IDENTIFY message will be evaluated.), this field will, however, be set to 3.

Peripheral Device Type This field is normally set to 1. When an Unsupported LUN condition exists , this field will, however, be set to 1Fh.

Page Code This field will be set to the value of the Page Code field in the Command Descriptor Block.

Page Length This field specifies the length in bytes of the parameters that follow the Page Length field.

Revision Levels These are all two ASCII characters representing the revision level of different parts of the Drive's hardware. The string is terminated with a zero (00h) character.

9.3.2.6. PROM Microcode Revision Level

BYTE	BIT 7	6	5	4	3	2	1	0
00	Peripheral Qualifier			Peripheral Device Type				
01	Page Code = C1h							
02	RESERVED							
03	Page Length = 11h							
04 05 06 07	Main Microcode Revision Level							
08	Main Microcode Release Status							
09 10 11 12	Main Microcode Branch Revision Level							
13 14	Main Microcode ID							
15 16 17 18	DSP Microcode Revision Level							
19	DSP Microcode Release Status							
20	End Of String = 00h							

Table 9-8: PROM Microcode Revision Level

Peripheral Qualifier This field will normally be set to zero. When an Unsupported LUN condition exists (if an IDENTIFY message is received, the LUN field in the Command descriptor block will be ignored and only the LUN field in the IDENTIFY message will be evaluated.), this field will, however, be set to 3.

Peripheral Device Type This field is normally set to 1. When an Unsupported LUN condition exists , this field will, however, be set to 1Fh.

Page Code This field will be set to the value of the Page Code field in the Command Descriptor Block.

Page Length This field specifies the length in bytes of the parameters that follow the Page Length field.

Main Microcode Revision Level Four ASCII characters showing the microcode revision number. The two most significant bytes are incremented by “ 1” for every major code revision. The two least significant bytes are incremented by 1 each time new code is made.

Main Microcode Release Status

A single ASCII character designating if the microcode was released for the customers or if it is microcode for internal use.

This field is not used and will always return the character " D"

Main Microcode Branch Revision Level

Four ASCII characters showing the revision number of a branched microcode. The use is same as described for Main Microcode Revision Level field above.

Main Microcode ID

Two ASCII characters designating custom version of the microcode.

DSP Microcode Revision Level

Four ASCII characters showing the DSP microcode revision number. The two most significant bytes are incremented by " 1" for every major code revision. The two least significant bytes are incremented by 1 each time new code is made.

DSP Microcode Release Status

A single ASCII character designating if the DSP microcode was released for the customers or if it is microcode for internal use.

This field is not used and will always return the character " D"

9.3.2.7. Drive Manufacturing Date

BYTE	BIT 7	6	5	4	3	2	1	0
00	Peripheral Qualifier			Peripheral Device Type				
01	Page Code = C2h							
02	RESERVED							
03	Page Length = 09h							
04 05	Drive Manufacturing Date – Month							
06	"."							
07 08	Day							
09	"."							
10 11	Year							
12	End Of String = 00h							

Table 9-9: Drive Manufacturing Date Page

Peripheral Qualifier
This field will normally be set to zero. When an Unsupported LUN condition exists (if an IDENTIFY message is received, the LUN field in the Command descriptor block will be ignored and only the LUN field in the IDENTIFY message will be evaluated.), this field will, however, be set to 3.

Peripheral Device Type
This field is normally set to 1. When an Unsupported LUN condition exists, this field will, however, be set to 1Fh.

Page Code
This field will be set to the value of the Page Code field in the Command Descriptor Block.

Page Length
This field specifies the length in bytes of the parameters that follow the Page Length field.

Drive Manufacturing Date
This is 8 ASCII characters representing the manufacturing date on the format 'MM.DD.YY'. The string is terminated with a zero (00h) character.

9.3.2.8. PROM Microcode Creation Date

BYTE	BIT 7	6	5	4	3	2	1	0
00	Peripheral Qualifier			Peripheral Device Type				
01	Page Code = C3h							
02	RESERVED							
03	Page Length = 12h							
04 05	Main Microcode Creation Date – Month							
06	"."							
07 08	Day							
09	"."							
10 11	Year							
12	"/"							
13 14	DSP Microcode Creation Date – Month							
15	"."							
16 17	Day							
18	"."							
19 20	Year							
21	End Of String = 00h							

Table 9-10: PROM Microcode Creation Date Page

Peripheral Qualifier This field will normally be set to zero. When an Unsupported LUN condition exists (If an IDENTIFY message is received, the LUN field in the Command descriptor block will be ignored and only the LUN field in the IDENTIFY message will be evaluated.), this field will, however, be set to 3.

Peripheral Device Type This field is normally set to 1. When an Unsupported LUN condition exists, this field will, however, be set to 1Fh.

Page Code This field will be set to the value of the Page Code field in the Command Descriptor Block.

Page Length This field specifies the length in bytes of the parameters that follow the Page Length field.

Main Microcode Creation Date This is 8 ASCII characters representing the Microcode creation date on the format 'MM.DD.YY'.

DSP Microcode Creation Date This is 8 ASCII characters representing the DSP Microcode creation date on the format 'MM.DD.YY'.

9.3.2.9. Drive Adjustment Date

BYTE	BIT 7	6	5	4	3	2	1	0
00	Peripheral Qualifier			Peripheral Device Type				
01	Page Code = C4h							
02	RESERVED							
03	Page Length = 09h							
04 05	Drive Adjustment Date – Month							
06	"."							
07 08	Day							
09	"."							
10 11	Year							
12	End Of String = 00h							

Table 9-11: Drive Adjustment Date Page

Peripheral Qualifier This field will normally be set to zero. When an Unsupported LUN condition exists (If an IDENTIFY message is received, the LUN field in the Command descriptor block will be ignored and only the LUN field in the IDENTIFY message will be evaluated.), this field will, however, be set to 3.

Peripheral Device Type This field is normally set to 1. When an Unsupported LUN condition exists, this field will, however, be set to 1Fh.

Page Code This field will be set to the value of the Page Code field in the Command Descriptor Block.

Page Length This field specifies the length in bytes of the parameters that follow the Page Length field.

Drive Adjustment Date These 8 ASCII characters represent the date of the last drive adjustment on the format 'MM.DD.YY'. The string is terminated with a zero (00h) character.

9.4. Exception Handling

See the section on *Error Conditions For All Commands*.

If the EVPD bit is not set and the Page Code is not set to zero, the Drive will return CHECK CONDITION status. No parameter data will be sent. The Error Code will be set to INVALID FIELD IN CDB.

If the EVPD bit is set and the Page Code is unknown, the Drive will return CHECK CONDITION status. No parameter data will be sent. The Error Code will be set to INVALID FIELD IN CDB.

9.5. Phase Sequencing

In this section the possible SCSI-bus phase sequences during execution of the command are described. Section 3.2 has more details about the generic phases in the brackets.

<sequence 1> := <initiator-part> <message-out> <command> <data-in> <completed>

10. Load/Unload

10.1. Command Description

When a tape cartridge is manually inserted, the Drive will automatically position the tape at BOM, which means that the tape is *physically* loaded. To prepare the Drive for media access commands, the tape has to be *logically* loaded. This is achieved by issuing a LOAD command. This command may also be used to request a retension function.

It is possible to configure the Drive for Auto Load, Auto Retension and Conditional Retension operations (see the MODE SELECT section for details).

The LOAD command (Load bit set to one) will write any buffered data to the tape. The tape is rewound to BOT. If the medium type is SLRtape140 to SLRtape7 or SLR32, the media header is updated. After successful execution of a LOAD command the tape is positioned at the beginning of partition zero and all media access commands are permissible.

The UNLOAD command (Load bit set to zero) will write any buffered data to the tape. The tape is rewound to BOT. If the medium type is SLRtape140 to SLRtape7 or SLR32, the media header is updated. The tape is then positioned at BOM or EOT determined by the EOT-bit. If media removal is not prevented (see PREVENT/ALLOW MEDIA REMOVAL command) the cartridge is ejected. If media removal is prevented, the cartridge is not ejected and the command is terminated with CHECK CONDITION status. After this error condition the tape is logically unloaded and no media access commands are permissible. A subsequent LOAD command will logically load the tape again and all media access commands are permissible.

If immediate operation is requested (IMM bit set to one), the Drive will be logically loaded (Load bit set to one) or unloaded (Load bit set to zero) even if the tape has not reached its final destination.

When the Drive is in buffered mode, it will discard any buffered data when a LOAD/UNLOAD command is validated if the previous command was terminated with CHECK CONDITION.

It will not be considered an error when multiple LOAD/UNLOAD commands are received in a sequence (as long as the first LOAD/UNLOAD command executed with no error).

The Drive will disconnect during execution of this command if disconnection is allowed.

10.2. Command Descriptor Block

BYTE	BIT 7	6	5	4	3	2	1	0
00	Operation Code **1Bh**							
01	Logical Unit Number (LUN)			RESERVED				IMM
02	RESERVED							
03	RESERVED							
04	RESERVED					EOT	RET	Load
05	Control Byte							

Table 10-1: LOAD/UNLOAD Command Descriptor Block

IMM An Immediate (IMM) bit of zero indicates that the Drive will not return status until the LOAD/UNLOAD operation has completed. An IMM bit of one indicates that the Drive will return status as soon as the execution of all previous commands have been completed and the Command Descriptor Block of the LOAD/UNLOAD command has been validated.

RET A Retension (RET) bit of one indicates that the Drive will perform a retension pass before the load or unload operation is performed. Retension means moving the tape one complete pass between EOT and BOT.

Load A Load bit of one indicates that the tape will be logically loaded and moved to BOM. The tape is logically loaded which means that the Drive is able to accept medium access commands. A Load bit of zero indicates that the tape is logically unloaded. The Drive will no longer accept media access commands.

EOT An End Of Tape (EOT) bit of zero indicates that the tape will be positioned at BOM after the unload operation has been performed. An EOT bit of one indicates that the tape will be positioned at EOT after the unload operation has been performed. This allows fast retensioning of the cartridge next time it is used.

Combinations of the EOT, RET and Load bits are shown in the table below:

EOT	RET	Load	Operation Performed
0	0	0	Unload, move to BOM
0	0	1	Load, move to BOM
0	1	0	Retension, Unload, move to BOM
0	1	1	Retension, Load, move to BOM
1	0	0	Unload, move to EOT
1	0	1	Illegal, CHECK CONDITION
1	1	0	Retension, Unload, move to EOT
1	1	1	Illegal, CHECK CONDITION

Table 10-2: LOAD/UNLOAD Operations

10.3. Exception Handling

If CHECK CONDITION status is returned for a LOAD/UNLOAD command with an IMM bit of one, the load or unload operation has not been performed.

See the sections on *Error Conditions For All Commands*, *Deferred Errors* and *Error Conditions For Media Access Commands*.

If the LINK and IMM bits both are set, then the Drive will return CHECK CONDITION status. The Error Code will be set INVALID FIELD IN CDB.

If an illegal combination of Load, EOT and RET bits is detected, the Drive returns CHECK CONDITION status. The Error Code will be set to INVALID FIELD IN CDB.

If medium removal is prevented, the UNLOAD command (Load bit set to zero) returns CHECK CONDITION status. The Error Code will be set to MEDIUM REMOVAL PREVENTED.

If the physical eject operation fails, the UNLOAD command (Load bit set to zero) returns CHECK CONDITION status. The Error Code will be set to MEDIA LOAD OR EJECT FAILED.

10.4. Phase Sequencing

In this section the possible SCSI-bus phase sequences during execution of the command are described. Section 3.2 has more details about the generic phases in the brackets.

<sequence 1> := <initiator-part> <message-out> <command> <disconnect> <reconnect> <completed>

This sequence will be used for all LOAD/UNLOAD commands.

<sequence 2> := <initiator-part> <message-out> <command> <completed>

This sequence will be used when the LOAD/UNLOAD command is executed and host does not allow disconnection.

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11. Locate

11.1. Command Description

The LOCATE command causes the Drive to position the tape to a specified position in the data stream. Both physical and logical positions are supported.

Logical LOCATE Command

The logical LOCATE command does not need special keys to get to a certain logical position. The Block Address in the CDB will for this command be interpreted as the logical block position, meaning the number of blocks seen on the SCSI-bus from BOP. The current logical position can be read by the READ POSITION command.

When using a SLRtape140 to SLRtape7 or SLR32 medium, tapemarks on the tape count as one logical block each. When using other tape media, tapemarks are *not* counted as logical blocks.

Physical LOCATE Command

The usage of the physical LOCATE is only legal when using SLR5 or DC9250 type media on SLR50 drives (physical LOCATE is not supported by the SLR140, SLR100, SLR75, SLR60 and SLR7 drives). The physical LOCATE command will interpret the Block Address in the CDB as a special key or “ bookmark” . All blocks and tapemarks can be identified with such a key. This position key can be obtained with the use of the READ POSITION command. While writing (or reading), the READ POSITION command is typically executed every time the tape is at a position that the Host system might want to go back to at a later stage. The returned position key can then be stored and used later as an input to the LOCATE command. These values can be regarded as keys that are unique to any given physical position on the tape. It might, however, be several keys that will result in the same logical position, as some physical tape blocks do not have any logical contents (i.e. ECC blocks or Filler blocks). The physical position numbers must be obtained with the READ POSITION command, and must not be manipulated in any way by the Host system. The LOCATE command will then bring the tape back to the same position as it was when the READ POSITION command was executed.

If a physical LOCATE command is issued to an ECC block, the drive will position the tape to the next physical data block.

If a physical LOCATE command is issued to a filler block, the drive will position the tape to the next physical data block.

If a physical LOCATE command is issued to an ID block, the drive will position the tape to the next physical data block.

If a physical LOCATE is issued into a Data Compression Unit block, the drive will position the tape at the next Data Compression Unit block.

11.2. Command Descriptor Block

BYTE	BIT 7	6	5	4	3	2	1	0
00	Operation Code **2Bh**							
01	Logical Unit Number (LUN)			RESERVED		BT	CP	IMM
02	RESERVED							
03 04 05 06	Block Address							
07	RESERVED							
08	Partition							
09	Control Byte							

Table 11-1: LOCATE Command Descriptor Block

BT

When the Block address Type (BT) bit is cleared, the Block Address field in the CDB will be the logical block identifier for the LOCATE operation. If the BT bit is set, the Block Address field in the CDB will be the physical block identifier.

When using SLRtape140 to SLRtape7 or SLR32, media, the BT bit must be set to zero. On the SLR140, SLR100, SLR75, SLR60 and SLR7 drives the BT bit must always be set to zero. Only logical block identifiers are supported.

CP

A change partition (CP) bit of one indicates that a change to the partition specified in the Partition field is to occur prior to positioning to the physical block specified in the Block Address field. A CP bit of one is only valid when using SLRtape140 to SLRtape7 or SLR32, media. A CP bit of zero indicates that no partition change is to be made and the Partition field is to be ignored.

IMM

The drive does not support immediate operations on this command. The immediate (IMM) bit must be set to zero.

Block Address

The input to the LOCATE command can be either *physical* or *logical* block identifiers. After a successful command execution, the logical tape position will be located before the specified block (beginning-of-media side).

A LOCATE to the block address one greater than the last block in the partition will return GOOD status. A LOCATE to a block more than 1 block beyond the last block in the partition will return CHECK CONDITION (see the section on *Exception Handling* below).

Partition

The partition field specifies which partition to select if the CP bit is one. The Drive can have up to 36 partitions. See section *2.3 Partitions Within a Volume* for information on how to use partitions.

11.3. Exception Handling

See the sections on *Error Conditions For All Commands*, *Deferred Errors* and *Error Conditions For Media Access Commands*.

If the BT bit is set to one and the loaded medium is a SLRtape140 to SLRtape7 or SLR32, medium, the LOCATE command will be terminated with CHECK CONDITION status. The Error Code will be set to Invalid field in CDB.

If the CP bit is set to one and the loaded medium is an SLR5 or DC9250 medium the LOCATE command will be terminated with CHECK CONDITION status. The Error Code will be set to INVALID FIELD IN CDB.

If the IMM bit is not set to zero, the LOCATE command will be terminated with CHECK CONDITION status. The Error Code will be set to INVALID FIELD IN CDB.

If the number found in the Partition field is not in the legal range (refer to the partition section of this chapter), then the LOCATE command will return CHECK CONDITION status. The Error Code will be set to INVALID FIELD IN CDB. The logical tape position will not change.

If the Drive is not able to find any data on the inserted cartridge, the cartridge is assumed to be blank and the LOCATE command will be terminated with CHECK CONDITION. The Error code will be set to END-OF DATA DETECTED or RECORDED ENTITY NOT FOUND.

If the specified location can not be found on the tape, the Drive will terminate the LOCATE command with CHECK CONDITION status. The Error Code will be set to END OF DATA DETECTED.

A CHECK CONDITION caused by early termination of any SPACE command never results in a negative value in the Information Bytes (the residual count) returned by the REQUEST SENSE command.

11.4. Phase Sequencing

In this section the possible SCSI-bus phase sequences during execution of the command are described. Section 3.2 has more details about the generic phases in the brackets.

<sequence 1> := <initiator-part> <message-out> <command> <disconnect> <reconnect> <completed>

The Drive will disconnect when the CDB has been transferred. The Drive will reconnect when the specified block has been located (or an error has been detected).

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12. Log Select

12.1. Command Description

The LOG SELECT command is used to modify statistical information related to the media and maintained by the Drive or to activate surveillance thresholds to monitor selected events in the Drive[1].

The log information consists of numerous counters related to drive use and write/read operations to/from the magnetic tape.

The parameter list is transferred during the DATA OUT phase of the command. If disconnect is allowed, the Drive disconnects while the transferred parameters are processed.

12.2. Command Descriptor Block

BYTE	BIT 7	6	5	4	3	2	1	0
00	Operation Code **4Ch**							
01	Logical Unit Number (LUN)			RESERVED			PCR	SP
02	PC		RESERVED					
03	RESERVED							
04	RESERVED							
05	RESERVED							
06	RESERVED							
07 08	Parameter List Length							
09	Control Byte							

Table 12-1: LOG SELECT Command Descriptor Block

[1] Note that the *log counter updates* are not necessarily synchronized with the events that they monitor. This means that threshold comparison can not be used to monitor drive actions with any great amount of precision.

PCR

If the Parameter Code Reset (PCR) bit is be set to 1 and the Parameter List Length is 0, all modifiable cumulative counters with their DU bits, counter thresholds, ETC and TMC fields in parameter control byte are set to their default values (the PC-field is ignored.).

The default value of the cumulative counters are 0 (zero). The default value of the counter thresholds is their maximum value (FFFFh, FFFFFFFFFh etc.). The default value of the ETC field is 0b. The default value of the TMC field is 11b.

If the PCR bit is set to zero, the log parameters is not reset.

SP

If the SP bit is set to 1 the Drive saves all Log parameters identified as savable by the DS bit (after performing the specified LOG SELECT operation).

If the Save Parameter (SP) bit is set to 0, the command is performed and no parameters are saved.

PC

The page control (PC) field defines the type of parameter values to be selected:

00b : The initiator can update any or all of the LOG SELECT parameter threshold values. New threshold values are transferred as LOG-pages in the DATA-OUT phase of the command. Both the pages and parameters must be sent in ascending order by the page/parameter code values.

01b : The initiator can update any or all of the LOG SELECT parameter accumulated values. New accumulated values are transferred as LOG-pages in the DATA-OUT phase of the command. Both the pages and parameters must be sent in ascending order by the page/parameter code values.

10b : All the LOG SELECT threshold values, their ETC and TMC control fields are set to their default values. See the description of the PCR bit for a definition of what is meant by default value. No parameters are transferred and the Parameter List Length must be 0000h.

11b : All the modifiable LOG SELECT parameter accumulated values and their control bytes are reset to their default values. See the description of the PCR bit for a definition of what is meant by default value. No parameters are transferred and the Parameter List Length must be 0000h.

Parameter List Length

These two bytes specify the length of the parameter list that will be transferred during the DATA-OUT phase of the command. A Parameter List Length must neither result in the truncation of any Log parameter nor exceed the actual size of the list.

A Parameter List Length of zero is legal and indicates that no parameters will be transferred.

12.3. Parameter List

12.3.1. General Parameter Description

See the LOG SENSE command for a description of all LOG pages/parameters supported by the Drive.

A LOG-page consists of a 4-byte header and one or more parameter blocks.

If more than one LOG-page is transferred in a LOG SELECT command, the pages must be transferred in an ascending order by page code.

If more than one parameter block is transferred in a page, the parameters must be transferred in an ascending order by parameter code.

It is not required to transfer all parameters defined in a LOG-page, but it is required that given page size match exactly the size of all currently present parameter blocks. The parameter blocks are 5, 6, 7, 8 or 12 bytes long for this Drive.

The Supported Pages page is NOT legal during LOG SELECT.

12.3.2. Log Page Headers

The first two bytes of LOG-page header must exactly match the page description presented in LOG SENSE chapter.

The remaining two bytes, the Page Length, must exactly match the total size of parameter blocks transferred within the page.

12.3.3. Log Parameter Headers

The first two bytes of parameter header must exactly match the parameter header description presented in LOG SENSE chapter.

The header byte n+2, the Parameter Control Byte, must be set as shown below:

BYTE	BIT 7	6	5	4	3	2	1	0
n+2	DU	DS	TSD	ETC	TMC		LBIN	LP

Table 12-2: Parameter Control Byte

DU When Disable Update (DU) bit is set to 1, it indicates that the drive shall not update the associated parameter value except in response to a LOG SELECT command.

When the DU bit is set to 0, it indicates that the drive shall update the associated parameter to reflect all events that should be noted by that parameter.

The DU bit can be set to 1 only when the corresponding parameter is listed as modifiable and when PC field is set 01b. Otherwise the command is terminated with CHECK CONDITION status.

The default value is 0b.

DS, TDS These bits must be set to values specified for each parameter in the LOG SENSE section.

ETC[1] An Enable Threshold Comparison (ETC) bit of 1 indicates that a comparison to the threshold value is to be performed whenever the cumulative value is updated by drive’s internal event.

A ETC bit of 0 that a comparison is not to be performed.

The value of the ETC bit is the same for cumulative and threshold parameters.

The default value is 0b.

TMC The TMC defines the basis for comparison of the cumulative and threshold values. The Threshold Met Criteria (TMC) field is valid only if ETC bit is 1. The following values are legal:

00b : Every update of the cumulative value by drive’s internal event gives a TRUE comparison.

01b : Only the updates by which the cumulative value reach or pass through the threshold value gives a TRUE comparison.

10b : Only the updates of the cumulative value to a value different than the threshold gives a TRUE comparison.

11b : Only the updates of the cumulative value to a value greater than the threshold gives a TRUE comparison.

If the result of comparison is TRUE and RLEC bit in MODE SELECT Control Mode page (0Ah) is set to 1, a Unit Attention condition will be generated for all initiators. The Drive reports CHECK CONDITION status and the Error Code will be THRESHOLD CONDITION MET.

The value of the TMC field is the same for cumulative and threshold parameters. The default value is 11b.

LBIN, LP These bits must be set to values specified for each parameter in the LOG SENSE section.

[1] See the parameter description in the LOG SENSE command section to ensure that threshold comparison is supported for the parameter in question.

The header byte n+3, the Parameter Length, must exactly match the length of Parameter Value field.

12.3.4. Modifiable Parameter Values

Only the following parameters can be modified by LOG SELECT command:

- Buffer Overrun Counter
- Buffer Underrun Counter
- Rewrite Counter
- Total Write Error Counter
- Total Write Error Corrected Counter
- Total Bytes Written Counter
- Total Uncorrected Write Error Counter
- Reread Counter
- Total Read Error Counter
- Total Read Error Corrected Counter
- ECC Correction Counter
- Total Bytes Read Counter
- Total Uncorrected Read Error Counter
- ECC Error Counter
- TapeAlert Flags
- Logical Data Block Counter
- Write Media Block Counter
- Read Media Block Counter
- Filemark Counter
- Setmark Counter
- Servo Lock Retry Counter
- Servo Track Seek Counter
- Write Servo Lock Lost Counter
- Write Servo Dropout Counter
- Read Servo Lock Lost Counter
- Read Servo Dropout Counter

Any attempt to modify other Log Parameter Values and their DU bits will be ignored.

12.3.5. The TapeAlert Information Page

The supported TapeAlert flags may be set to one in a Log Select with PCR set to zero and PC set to 01b. Any attempts to set other flags will be ignored.

NOTE: The possibility to set the supported TapeAlert flags with a Log Select is included for test purpose only.

12.4. Exception Handling

See the section on *Error Conditions For All Commands*.

If PCR bit is one and Parameter List Length is NOT zero the Drive will return CHECK CONDITION status. No parameters will be transferred, and the Error Code will be INVALID FIELD IN CDB.

If PC field is 10b or 11b and Parameter List Length is NOT zero the Drive will return CHECK CONDITION status. No parameters will be transferred, and the Error Code will be INVALID FIELD IN CDB.

If the Parameter List Length do not match exactly the real length of the requested LOG-pages, the Drive will report CHECK CONDITION status and the Error Code will be INVALID FIELD IN CDB. No log select operation will be performed.

If any bits or bytes in the transferred parameters have invalid values, the Drive will report CHECK CONDITION status and the Error Code will be INVALID FIELD IN PARAMETER LIST. No log select operation will be performed.

If the parameter blocks are not transferred in an ascending order of parameter code, the Drive will report CHECK CONDITION status and the Error Code will be INVALID FIELD IN PARAMETER LIST. No log select operation will be performed.

12.5. Phase Sequencing

In this section the possible SCSI-bus phase sequences during execution of the command are described. Section 3.2.1 has more details about the generic phases in the brackets.

<sequence 1> := <initiator-part> <message-out> <command> <disconnect> <reconnect> <data-out> <completed>

When disconnection is allowed the Drive will disconnect when the CDB has been transferred. The Drive will reconnect when the previous immediate command has completed execution.

<sequence 2> := <initiator-part> <message-out> <command> <data-out> <completed>

This sequence will be used when disconnection is not allowed.

13. Log Sense

13.1. Command Description

The LOG SENSE command is used to retrieve statistical information maintained by the Drive[1].

The log information consists of numerous counters related to Drive use and write/read operations to/from the magnetic tape. When the Log Sense command is issued, the Drive will return the requested parameter page(s).

Power-on or Hard Reset will set the counters either to zero or to the last saved value. They are set to the last saved value only when the counter is identified as savable (the DS and TSD bits are zero).

The parameter list is transferred during the DATA IN phase of the command. If the disconnect is allowed, the Drive will disconnect when executing this command.

13.2. Command Descriptor Block

BYTE	BIT 7	6	5	4	3	2	1	0
00	Operation Code **4Dh**							
01	Logical Unit Number (LUN)			RESERVED			PPC	SP
02	PC		Page Code					
03	RESERVED							
04	RESERVED							
05 06	Parameter Pointer							
07 08	Allocation Length							
09	Control Byte							

Table 13-1: LOG SENSE Command Descriptor Block

PPC The parameter Pointer Control (PPC) bit MUST be set to zero.

SP If the SP bit is set to 1 the Drive saves[2] all Log parameters identified as savable by the DS bit (after performing the specified LOG SENSE operation).

If the Save Parameter (SP) bit is set to 0, the command is performed and no parameters are saved.

---

[1] Note that the log counter *updates* are not necessarily synchronized with the events that they monitor. This means that threshold comparison can not be used to monitor drive actions with any great amount of precision.

[2] The medium used to store saved log data is specified to handle up to 100000 save operations.

PC

The Page Control (PC) field indicates what type of parameter value the Drive returns to the initiator.

Note: For page 2Eh (TapeAlert) this field is ignored.

00b : Current Threshold Values
01b : Current Cumulative Values
10b : Default Threshold Values
11b : Default Cumulative Values

Page Code

The Page Code field specifies which page to return. Legal Page Codes are:

00h : Supported Log Pages Page
01h : Buffer Overrun/Underrun Counters Page
02h : Recoverable Write Error Counter Page
03h : Recoverable Read Error Counters Page
2Eh : TapeAlert Page
30h : Block Counter Page
31h : Remaining Capacity Page
32h : Tapemark Counter Page
33h : Head Cleaning Page
34h : Drive Page
35h : Servo Page
36h : Track Number Page
37h : Cartridge Usage Page
39h : Compression Ratio Page
3Eh : All Log Pages [1]

Parameter Pointer

The Parameter Pointer field MUST be set to zero to indicate that the Drive always transfers all supported parameter codes for each page.

Allocation Length

This field specifies the maximum number of bytes that the Initiator has allocated for returned LOG SENSE data. An Allocation Length of zero indicates that no LOG SENSE data is sent. The Drive terminates the DATA IN phase when Allocation Length bytes have been transferred or when all available LOG SENSE data have been transferred, whichever is less.

[1] If Log Sense is issued with a Page Code = 3Eh, the Drive will return all Log Pages in ascending order by Page Code.

13.3. Parameter List

13.3.1. Supported Log Pages

BYTE	BIT 7	6	5	4	3	2	1	0
00	RESERVED		Page Code = 00h					
01	RESERVED							
02 03	Page Length = 000Fh							
04	Supported Page = 00h							
05	Supported Page = 01h							
06	Supported Page = 02h							
07	Supported Page = 03h							
08	Supported Page = 2Eh							
09	Supported Page = 30h							
10	Supported Page = 31h							
11	Supported Page = 32h							
12	Supported Page = 33h							
13	Supported Page = 34h							
14	Supported Page = 35h							
15	Supported Page = 36h							
16	Supported Page = 37h							
17	Supported Page = 39h							
18	Retrieval of all supported pages, Code = 3Eh							

Table 13-2: Supported Log Pages Page

Page Code The Page Code for this page is 00h.

Page Length This field is set to 000Fh indicating that the Supported Log Pages page contains 15 bytes/page codes.

13.3.2. Buffer Overrun/Underrun Counters Page

BYTE	BIT 7	6	5	4	3	2	1	0
00	RESERVED		Page Code = 01h					
01	RESERVED							
02 03	Page Length = 000Ch							
04 | 09	Underrun Log Parameters							
10 | 15	Overrun Log Parameters							

Table 13-3: Buffer Overrun/Underrun Counters Page

Page Code The Page Code for this page is 01h.

Page Length This field is set to 000Ch indicating that the page parameters occupy 12 bytes.

Underrun Log Parameters

BYTE	BIT 7	6	5	4	3	2	1	0
n+0	RESERVED							
n+1	Count Basis			Cause				0
n+2	DU	DS	TSD	ETC	TMC		R	LP
n+3	Parameter Length = 02h							
n+4 n+5	Buffer Underrun Counter							

Table 13-4: Underrun Log Parameters

Count Basis This field is set to 0, to indicate, that the criteria for incrementing the counter is undefined.

Cause This field is set to 0, to indicate, that the reason for underrun is undefined.

DU A Disable Update (DU) bit set to 0 indicates that the Drive is free to update the counter.

A DU bit set to 1 indicates that the Drive shall not update the counter except in response to a LOG SELECT command that specifies a new value for the counter.

The initiator may use the LOG SELECT command to set or clear the DU bit.

The Drive will set the DU bit to 1 when the counter reaches its maximum value (FFFFh).

DS

The Disable Save (DS) bit is set to 1 to indicate that the **Drive does not support saving** of this log parameter.

(Note: This bit can not be changed by the initiator)

TSD

The Target Save Disable (TSD) bit is set to 1 to indicate that the Drive does not provide any Drive-defined method for saving of this log parameter.

(Note: This bit can not be changed by the initiator)

ETC

An Enable Threshold Comparison (ETC) bit indicates whether comparison to the threshold value is performed or not.

The default value is 0. See the LOG SELECT command for further description.

TMC

The Threshold Met Criteria (TMC) field is valid only if ETC bit is 1 and it selects one of four possible Threshold Met Criteria.

The default value is 11b. See the LOG SELECT command for further description.

LP

The List Parameters (LP) bit is set to 0 to indicate that the parameter is a data counter.

(Note: This bit can not be changed by the initiator)

Parameter Length

This field is set to 02h to indicate that the counter is 2 bytes wide.

Buffer Underrun Counter

This counter is incremented, each time, the tape Drive has to stop a pending write operation (and thus the tape motion) due to empty data buffer.

Overrun Log Parameters

BYTE	BIT 7	6	5	4	3	2	1	0
n+0	RESERVED							
n+1	Count Basis			Cause				1
n+2	DU	DS	TSD	ETC	TMC		R	LP
n+3	Parameter Length = 02h							
n+4 n+5	Buffer Overrun Counter							

Table 13-5: Overrun Log Parameters

Count Basis
This field is set to 0 to indicate that the criteria for incrementing the counter is undefined.

Cause
This field is set to 0 to indicate that the reason for overrun is undefined.

DU
The Disable Update (DU) bit set to 0 to indicate that the Drive is free to update the counter.

A DU bit set to 1 indicates that the Drive shall not update the counter except in response to a LOG SELECT command that specifies a new value for the counter.

The initiator may use the LOG SELECT command to set or clear the DU bit.

The Drive will set the DU bit to 1 when the counter reaches its maximum value (FFFFh).

DS
The Disable Save (DS) bit is set to 1 to indicate that the Drive **does not support saving** of this log parameter.

(Note: This bit can not be changed by the initiator)

TSD
The Target Save Disable (TSD) bit is set to 1 to indicate that the Drive does not provide any Drive-defined method for saving of this log parameter.

(Note: This bit can not be changed by the initiator)

ETC
An Enable Threshold Comparison (ETC) bit indicates whether comparison to the threshold value is performed or not.

The default value is 0. See the LOG SELECT command for further description.

TMC
The Threshold Met Criteria (TMC) field is valid only if ETC bit is 1 and it selects one of four possible Threshold Met Criteria.

The default value is 11b. See the LOG SELECT command for further description.

LP
The List Parameters (LP) bit is set to 0 to indicate that the parameter is a data counter.

(Note: This bit can not be changed by the initiator)

Parameter Length
This field is set to 02h to indicate that the counter is 2 bytes wide.

Buffer Overrun Counter
This counter is incremented, each time, the tape Drive has to stop a pending read operation (and thus the tape motion) due to full data buffer.

13.3.3. Write Error Counter Page

BYTE	BIT 7	6	5	4	3	2	1	0
00	RESERVED		Page Code = 02h					
01	RESERVED							
02 03	Page Length = 0038h							
04 | 15	Rewrite Counter Log Parameter							
16 | 23	Total Write Errors Log Parameter							
24 | 31	Total Write Errors Corrected Log Parameter							
32 | 39	Total Times Errors Processed Log Parameter							
40 | 51	Total Bytes Written Log Parameter							
52 | 59	Total Uncorrected Write Errors Log Parameter							

Table 13-6: Write Error Counter Page

Page Code The Page Code for this page is 02h.

Page Length This field is set to 0038h indicating that the page parameters occupy 56 bytes.

Rewrite Counter Log Parameters

BYTE	BIT 7	6	5	4	3	2	1	0
n+0 n+1	Parameter Code = 0001h							
n+2	DU	DS	TSD	ETC	TMC		R	LP
n+3	Parameter Length = 08h							
n+4 | n+11	Rewrite Counter							

Table 13-7: Rewrite Counter Log Parameters

Parameter Code

The Parameter Code is set to 0001h.

DU

A Disable Update (DU) bit set to 0 indicates that the Drive is free to update the counter.

A DU bit set to 1 indicates that the Drive shall not update the counter except in response to a LOG SELECT command that specifies a new value for the counter.

The initiator may use the LOG SELECT command to set or clear the DU bit.

The Drive sets the DU bit to 1 when the counter reaches its maximum value (FFFFFFFFFFFFFFFFh).

DS

The Disable Save (DS) bit is set to 0 to indicate that the Drive **does support saving** of this log parameter.

(Note: This bit can not be changed by the initiator)

TSD

The Target Save Disable (TSD) bit is set to 0. The Drive will save this log parameter each time a cartridge is unloaded.

(Note: This bit can not be changed by the initiator)

ETC

An Enable Threshold Comparison (ETC) bit indicates whether comparison to the threshold value is performed or not.

The default value is 0. See the LOG SELECT command for further description.

TMC

The Threshold Met Criteria (TMC) field is valid only if ETC bit is 1 and it selects one of four possible Threshold Met Criteria.

The default value is 11b. See the LOG SELECT command for further description.

LP

The List Parameters (LP) bit is set to 0 to indicate that the parameter is a data counter.

(Note: This bit can not be changed by the initiator)

Parameter Length

This field is set to 08h to indicate that the counter is 8 bytes wide.

Rewrite Counter

This counter counts re-writes during write operations. When a block is re-written (one or more times), the counter is incremented by one. The increment(s) are performed each time capstan motor stops.

Total Write Errors Log Parameters

BYTE	BIT 7	6	5	4	3	2	1	0
n+0 n+1	Parameter Code = 0002h							
n+2	DU	DS	TSD	ETC	TMC		R	LP
n+3	Parameter Length = 04h							
n+4 | n+7	Write Errors Counter							

Table 13-8: Total Write Errors Log Parameters

Parameter Code The Parameter Code is set to 0002h.

DU A Disable Update (DU) bit set to 0 indicates that the Drive is free to update the counter.

A DU bit set to 1 indicates that the Drive shall not update the counter except in response to a LOG SELECT command that specifies a new value for the counter.

The initiator may use the LOG SELECT command to set or clear the DU bit.

The Drive will set the DU bit to 1 when the counter reaches its maximum value (FFFFFFFFh).

DS The Disable Save (DS) bit is set to 1 to indicate that the Drive does **not support saving** of this log parameter.

(Note: This bit can not be changed by the initiator)

TSD The Target Save Disable (TSD) bit is set to 1 to indicate that the Drive does not provide any Drive-defined method for saving this log parameter.

(Note: This bit can not be changed by the initiator)

ETC An Enable Threshold Comparison (ETC) bit indicates whether comparison to the threshold value is performed or not.

The default value is 0. See the LOG SELECT command for further description.

TMC The Threshold Met Criteria (TMC) field is valid only if ETC bit is 1 and it selects one of four possible Threshold Met Criteria.

The default value is 11b. See the LOG SELECT command for further description.

LP The List Parameters (LP) bit is set to 0 to indicate that the parameter is a data counter.

(Note: This bit can not be changed by the initiator)

Parameter Length This field is set to 04h to indicate that the counter is 4 bytes wide.

Write Errors Counter This counter counts re-writes and uncorrectable write errors during write operations. The increment(s) are performed each time capstan motor stops.

Total Write Errors Corrected Log Parameters

BYTE	BIT 7	6	5	4	3	2	1	0
n+0 n+1	Parameter Code = 0003h							
n+2	DU	DS	TSD	ETC	TMC		R	LP
n+3	Parameter Length = 04h							
n+4 | n+7	Write Errors Corrected Counter							

Table 13-9: Total Write Errors Corrected Log Parameters

Parameter Code The Parameter Code is set to 0003h.

DU A Disable Update (DU) bit set to 0 indicates that the Drive is free to update the counter.

A DU bit set to 1 indicates that the Drive shall not update the counter except in response to a LOG SELECT command that specifies a new value for the counter.

The initiator may use the LOG SELECT command to set or clear the DU bit.

The Drive will set the DU bit to 1 when the counter reaches its maximum value (FFFFFFFFh).

DS The Disable Save (DS) bit is set to 1 to indicate that the Drive does **not support saving** of this log parameter.

(Note: This bit can not be changed by the initiator)

TSD The Target Save Disable (TSD) bit is set to 1 to indicate that the Drive does not provide any Drive-defined method for saving this log parameter.

(Note: This bit can not be changed by the initiator)

ETC An Enable Threshold Comparison (ETC) bit indicates whether comparison to the threshold value is performed or not.

The default value is 0. See the LOG SELECT command for further description.

TMC The Threshold Met Criteria (TMC) field is valid only if ETC bit is 1 and it selects one of four possible Threshold Met Criteria.

The default value is 11b. See the LOG SELECT command for further description.

LP The List Parameters (LP) bit is set to 0 to indicate that the parameter is a data counter.

(Note: This bit can not be changed by the initiator)

Parameter Length This field is set to 04h to indicate that the counter is 4 bytes wide.

Write Errors Corrected Counter

This counter counts re-writes during write operations. When a block is re-written (one or more times), the counter is incremented by one. The increment(s) are performed each time capstan motor stops.

(Note: This counter counts the same events as a counter in the parameter 0001 of this page, but it is not savable and is smaller.)

Total Times Errors Processed Log Parameters

BYTE	BIT 7	6	5	4	3	2	1	0
n+0 n+1	Parameter Code = 0004h							
n+2	DU	DS	TSD	ETC	TMC		R	LP
n+3	Parameter Length = 04h							
n+4 n+5	Counter (Reserved)							

Table 13-10: Total Times Errors Processed Log Parameters

Parameter Code

The Parameter Code is set to 0004h.

DU

The DU always maintains its default value of 0 and can not be changed.

DS

The Disable Save (DS) bit is set to 1 to indicate that the Drive does **not support saving** of this log parameter.

(Note: This bit can not be changed by the initiator)

TSD

The Target Save Disable (TSD) bit is set to 1 to indicate that the Drive does not provide any Drive-defined method for saving this log parameter.

(Note: This bit can not be changed by the initiator)

ETC

An Enable Threshold Comparison (ETC) bit is always 0 and indicates that the comparison will NOT be performed.

(Note: This bit can not be changed by the initiator)

TMC

The Threshold Met Criteria (TMC) field is not valid as the ETC bit is 0 and can’t be changed from its default value 11b.

LP

The List Parameters (LP) bit is set to 0 to indicate that the parameter is a data counter.

(Note: This bit can not be changed by the initiator)

Parameter Length

This field is set to 04h to indicate that the counter is 4 bytes wide.

Counter

This is a dummy counter that always returns 0. The counter is implemented only to promote ANSI SCSI-2 compatibility.

Total Bytes Written Log Parameters

BYTE	BIT 7	6	5	4	3	2	1	0
n+0 n+1	Parameter Code = 0005h							
n+2	DU	DS	TSD	ETC	TMC		R	LP
n+3	Parameter Length = 08h							
n+4 | n+11	Total Bytes Written Counter							

Table 13-11: Total Bytes Written Parameters

Parameter Code The Parameter Code is set to 0005h.

DU A Disable Update (DU) bit set to 0 indicates that the Drive is free to update the counter.

A DU bit set to 1 indicates that the Drive shall not update the counter except in response to a LOG SELECT command that specifies a new value for the counter.

The initiator may use the LOG SELECT command to set or clear the DU bit.

The Drive sets the DU bit to 1 when the counter reaches its maximum value (FFFFFFFFFFFFFFFFh).

DS The Disable Save (DS) bit is set to 1 to indicate that the Drive does **not support saving** of this log parameter.

(Note: This bit can not be changed by the initiator)

TSD The Target Save Disable (TSD) bit is set to 1 to indicate that the Drive does not provide any Drive-defined method for saving this log parameter.

(Note: This bit can not be changed by the initiator)

ETC An Enable Threshold Comparison (ETC) bit indicates whether comparison to the threshold value is performed or not.

The default value is 0. See the LOG SELECT command for further description.

TMC The Threshold Met Criteria (TMC) field is valid only if ETC bit is 1 and it selects one of four possible Threshold Met Criteria.

The default value is 11b. See the LOG SELECT command for further description.

LP The List Parameters (LP) bit is set to 0 to indicate that the parameter is a data counter.

Parameter Length This field is set to 08h to indicate that the counter is 8 bytes wide.

Total Bytes Written Counter This counter counts the bytes in physical blocks, written to the media, during write operations. The increment(s) are performed each time capstan motor stops. (The physical blocks are data blocks, control blocks, filler blocks, ECC blocks and tape marks.)

Total Uncorrected Write Errors Log Parameters

BYTE	BIT 7	6	5	4	3	2	1	0
n+0 n+1	Parameter Code = 0006h							
n+2	DU	DS	TSD	ETC	TMC		R	LP
n+3	Parameter Length = 04h							
n+4 | n+7	Uncorrectable Write Errors Counter							

Table 13-12: Total Uncorrected Write Errors Log Parameters

Parameter Code The Parameter Code is set to 0006h.

DU A Disable Update (DU) bit set to 0 indicates that the Drive is free to update the counter.

A DU bit set to 1 indicates that the Drive shall not update the counter except in response to a LOG SELECT command that specifies a new value for the counter.

The initiator may use the LOG SELECT command to set or clear the DU bit.

The Drive will set the DU bit to 1 when the counter reaches its maximum value (FFFFFFFFh).

DS The Disable Save (DS) bit is set to 1 to indicate that the Drive does **not support saving** of this log parameter.

(Note: This bit can not be changed by the initiator)

TSD The Target Save Disable (TSD) bit is set to 1 to indicate that the Drive does not provide any Drive-defined method for saving this log parameter.

(Note: This bit can not be changed by the initiator)

ETC An Enable Threshold Comparison (ETC) bit indicates whether comparison to the threshold value is performed or not.

The default value is 0. See the LOG SELECT command for further description.

TMC The Threshold Met Criteria (TMC) field is valid only if ETC bit is 1 and it selects one of four possible Threshold Met Criteria.

The default value is 11b. See the LOG SELECT command for further description.

LP The List Parameters (LP) bit is set to 0 to indicate that the parameter is a data counter.

(Note: This bit can not be changed by the initiator)

Parameter Length This field is set to 04h to indicate that the counter is 4 bytes wide.

Uncorrectable Write Error Counter This counter counts hard write errors.

13.3.4. Read Error Counter Page

BYTE	BIT 7	6	5	4	3	2	1	0
00	RESERVED			Page Code = 03h				
01	RESERVED							
02 03	Page Length = 0040h							
04 | 15	Reread Counter Log Parameters							
16 | 23	Total Read Error Log Parameters							
24 | 31	Total Read Error Corrected Log Parameters							
32 | 39	ECC Correction Counter Log Parameters							
40 | 51	Total Bytes Read Counter Log Parameters							
52 | 59	Total Uncorrected Read Errors Log Parameters							
60 | 67	ECC Error Counter Log Parameters							

Table 13-13: Read Error Counter Page

Page Code The Page Code for this page is 03h.

Page Length This field is set to 0040h indicating that the page parameters occupy 64 bytes.

Reread Counter Log Parameters

<table>
<tr><th>BYTE</th><th>BIT 7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th></tr>
<tr><td>n+0
n+1</td><td colspan="8">Parameter Code = 0001h</td></tr>
<tr><td>n+2</td><td>DU</td><td>DS</td><td>TSD</td><td>ETC</td><td colspan="2">TMC</td><td>R</td><td>LP</td></tr>
<tr><td>n+3</td><td colspan="8">Parameter Length = 08h</td></tr>
<tr><td>n+4
|
n+11</td><td colspan="8">Reread Counter</td></tr>
</table>

Table 13-14: Reread Counter Log Parameters

Parameter Code The Parameter Code is set to 0001h.

DU A Disable Update (DU) bit set to 0 indicates that the Drive is free to update the counter.

A DU bit set to 1 indicates that the Drive shall not update the counter except in response to a LOG SELECT command that specifies a new value for the counter.

The initiator may use the LOG SELECT command to set or clear the DU bit.

The Drive sets the DU bit to 1 when the counter reaches its maximum value (FFFFFFFFFFFFFFFFh).

DS The Disable Save (DS) bit is set to 0 to indicate that the Drive does **support saving** of this log parameter.

(Note: This bit can not be changed by the initiator)

TSD The Target Save Disable (TSD) bit is set to 0. The Drive will save this log parameter each time a cartridge is unloaded.

(Note: This bit can not be changed by the initiator)

ETC An Enable Threshold Comparison (ETC) bit indicates whether comparison to the threshold value is performed or not.

The default value is 0. See the LOG SELECT command for further description.

TMC The Threshold Met Criteria (TMC) field is valid only if ETC bit is 1 and it selects one of four possible Threshold Met Criteria.

The default value is 11b. See the LOG SELECT command for further description.

LP The List Parameters (LP) bit is set to 0 to indicate that the parameter is a data counter.

(Note: This bit can not be changed by the initiator)

Parameter Length This field is set to 08h to indicate that the counter is 8 bytes wide.

Reread Counter This counter counts re-reads during read operations. This counter is incremented by one, each time, a data frame must be re-read. (The tape is stopped, repositioned back and started again.)

Total Read Error Log Parameters

BYTE	BIT 7	6	5	4	3	2	1	0
n+0 n+1	Parameter Code = 0002h							
n+2	DU	DS	TSD	ETC	TMC		R	LP
n+3	Parameter Length = 04h							
n+4 | n+7	Total Read Error Counter							

Table 13-15: Total Read Error Parameters

Parameter Code The Parameter Code is set to 0002h.

DU A Disable Update (DU) bit set to 0 indicates that the Drive is free to update the counter.

A DU bit set to 1 indicates that the Drive shall not update the counter except in response to a LOG SELECT command that specifies a new value for the counter.

The initiator may use the LOG SELECT command to set or clear the DU bit.

The Drive will set the DU bit to 1 when the counter reaches its maximum value (FFFFFFFFh).

DS The Disable Save (DS) bit is set to 1 to indicate that the Drive does **not support saving** of this log parameter.

(Note: This bit can not be changed by the initiator)

TSD The Target Save Disable (TSD) bit is set to 1 to indicate that the Drive does not provide any Drive-defined method for saving of this log parameter.

(Note: This bit can not be changed by the initiator)

ETC An Enable Threshold Comparison (ETC) bit indicates whether comparison to the threshold value is performed or not.

The default value is 0. See the LOG SELECT command for further description.

TMC The Threshold Met Criteria (TMC) field is valid only if ETC bit is 1 and it selects one of four possible Threshold Met Criteria.

The default value is 11b. See the LOG SELECT command for further description.

LP The List Parameters (LP) bit is set to zero to indicate that the parameter is a data counter.

(Note: This bit can not be changed by the initiator)

Parameter Length This field is set to 08h to indicate that the counter is 8 bytes wide.

Total Read Error Counter This counter counts Rereads and ECC correction and Unrecoverable errors during read operations. The increment(s) are performed each time capstan motor stops.

Total Read Error Corrected Log Parameters

BYTE	BIT 7	6	5	4	3	2	1	0
n+0 n+1	Parameter Code = 0003h							
n+2	DU	DS	TSD	ETC	TMC		R	LP
n+3	Parameter Length = 04h							
n+4 | n+7	Total Read Error Corrected Counter							

Table 13-16: Total Read Error Corrected Log Parameters

Parameter Code The Parameter Code is set to 0003h.

DU A Disable Update (DU) bit set to 0 indicates that the Drive is free to update the counter.

A DU bit set to 1 indicates that the Drive shall not update the counter except in response to a LOG SELECT command that specifies a new value for the counter.

The initiator may use the LOG SELECT command to set or clear the DU bit.

The Drive will set the DU bit to 1 when the counter reaches its maximum value (FFFFFFFFh).

DS The Disable Save (DS) bit is set to 1 to indicate that the Drive does **not support saving** of this log parameter.

(Note: This bit can not be changed by the initiator)

TSD The Target Save Disable (TSD) bit is set to 1 to indicate that the Drive does not provide any Drive-defined method for saving of this log parameter.

(Note: This bit can not be changed by the initiator)

ETC An Enable Threshold Comparison (ETC) bit indicates whether comparison to the threshold value is performed or not.

The default value is 0. See the LOG SELECT command for further description.

TMC The Threshold Met Criteria (TMC) field is valid only if ETC bit is 1 and it selects one of four possible Threshold Met Criteria.

The default value is 11b. See the LOG SELECT command for further description.

LP The List Parameters (LP) bit is set to zero to indicate that the parameter is a data counter.

(Note: This bit can not be changed by the initiator)

Parameter Length This field is set to 08h to indicate that the counter is 8 bytes wide.

Total Read Error Corrected Counter This counter counts Rereads and ECC correction during read operations. The increment(s) are performed each time capstan motor stops.

ECC Correction Counter Log Parameters

BYTE	BIT 7	6	5	4	3	2	1	0
n+0 n+1	Parameter Code = 0004h							
n+2	DU	DS	TSD	ETC	TMC		R	LP
n+3	Parameter Length = 04h							
n+4 | n+7	ECC Correction Counter							

Table 13-17: ECC Correction Counter Log Parameters

Parameter Code The Parameter Code is set to 0004h.

DU A Disable Update (DU) bit set to 0 indicates that the Drive is free to update the counter.
A DU bit set to 1 indicates that the Drive shall not update the counter except in response to a LOG SELECT command that specifies a new value for the counter.
The initiator may use the LOG SELECT command to set or clear the DU bit.
The Drive sets the DU bit to 1 when the counter reaches its maximum value (FFFFFFFFh).

DS The Disable Save (DS) bit is set to 1 to indicate that the Drive does **not support saving** of this log parameter.
(Note: This bit can not be changed by the initiator)

TSD The Target Save Disable (TSD) bit is set to 1 to indicate that the Drive does not provide any Drive-defined method for saving of this log parameter.
(Note: This bit can not be changed by the initiator)

ETC An Enable Threshold Comparison (ETC) bit indicates whether comparison to the threshold value is performed or not.
The default value is 0. See the LOG SELECT command for further description.

TMC The Threshold Met Criteria (TMC) field is valid only if ETC bit is 1 and it selects one of four possible Threshold Met Criteria.
The default value is 11b. See the LOG SELECT command for further description.

LP The List Parameters (LP) bit is set to zero to indicate that the parameter is a data counter.
(Note: This bit can not be changed by the initiator)

Parameter Length This field is set to 04h to indicate that the counter is 4 bytes wide.

ECC Correction Counter This counter counts the number of blocks corrected by ECC during tape read operations.
This counter can be incremented during following SCSI commands: read, verify, space forward, space reverse, fast space and locate, or during “ read ahead” .
When the medium used is an SLR5 or DC9250 type medium and corrections are made the counter is updated once per (16 blocks) data frame. When the medium used is a SLRtape140 to SLRtape7 or SLR32, medium and corrections are made the counter is updated twice per (64 blocks) data frame.

Total Bytes Read Counter Log Parameters

BYTE	BIT 7	6	5	4	3	2	1	0
n+0 n+1	Parameter Code = 0005h							
n+2	DU	DS	TSD	ETC	TMC		R	LP
n+3	Parameter Length = 08h							
n+4 | n+11	Total Bytes Read Counter							

Table 13-18: Total Bytes Read Counter Log Parameters

Parameter Code The Parameter Code is set to 0005h.

DU A Disable Update (DU) bit set to 0 indicates that the Drive is free to update the counter.

A DU bit set to 1 indicates that the Drive shall not update the counter except in response to a LOG SELECT command that specifies a new value for the counter.

The initiator may use the LOG SELECT command to set or clear the DU bit.

The Drive sets the DU bit to 1 when the counter reaches its maximum value (FFFFFFFFFFFFFFFFh).

DS The Disable Save (DS) bit is set to 1 to indicate that the Drive does **not support saving** of this log parameter.

(Note: This bit can not be changed by the initiator)

TSD The Target Save Disable (TSD) bit is set to 1 to indicate that the Drive does not provide any Drive-defined method for saving of this log parameter.

(Note: This bit can not be changed by the initiator)

ETC An Enable Threshold Comparison (ETC) bit indicates whether comparison to the threshold value is performed or not.

The default value is 0. See the LOG SELECT command for further description.

TMC The Threshold Met Criteria (TMC) field is valid only if ETC bit is 1 and it selects one of four possible Threshold Met Criteria.

The default value is 11b. See the LOG SELECT command for further description.

LP The List Parameters (LP) bit is set to 0 to indicate that the parameter is a data counter.

(Note: This bit can not be changed by the initiator)

Parameter Length This field is set to 08h to indicate that the counter is 8 bytes wide.

Total Bytes Read Counter This counter counts bytes, read from the media, during Read and Space operations. The increment(s) are performed each time capstan motor stops. The counter will remain unchanged during Space reverse, Space EOD, Fast Space or on Locate operations.

Total Uncorrected Read Errors Log Parameters

BYTE	BIT 7	6	5	4	3	2	1	0
n+0 n+1	Parameter Code = 0006h							
n+2	DU	DS	TSD	ETC	TMC		R	LP
n+3	Parameter Length = 04h							
n+4 | n+7	Uncorrectable Read Errors Counter							

Table 13-19: Total Uncorrected Read Errors Log Parameters

Parameter Code The Parameter Code is set to 0006h.

DU A Disable Update (DU) bit set to 0 indicates that the Drive is free to update the counter.

A DU bit set to 1 indicates that the Drive shall not update the counter except in response to a LOG SELECT command that specifies a new value for the counter.

The initiator may use the LOG SELECT command to set or clear the DU bit.

The Drive will set the DU bit to 1 when the counter reaches its maximum value (FFFFFFFFh).

DS The Disable Save (DS) bit is set to 1 to indicate that the Drive does **not support saving** of this log parameter.

(Note: This bit can not be changed by the initiator)

TSD The Target Save Disable (TSD) bit is set to 1 to indicate that the Drive does not provide any Drive-defined method for saving this log parameter.

(Note: This bit can not be changed by the initiator)

ETC An Enable Threshold Comparison (ETC) bit indicates whether comparison to the threshold value is performed or not.

The default value is 0. See the LOG SELECT command for further description.

TMC The Threshold Met Criteria (TMC) field is valid only if ETC bit is 1 and it selects one of four possible Threshold Met Criteria.

The default value is 11b. See the LOG SELECT command for further description.

LP The List Parameters (LP) bit is set to 0 to indicate that the parameter is a data counter.

(Note: This bit can not be changed by the initiator)

Parameter Length This field is set to 04h to indicate that the counter is 4 bytes wide.

Uncorrectable Read Error Counter This counter counts hard read errors.

ECC Error Counter Log Parameters

<table>
<tr><th>BYTE</th><th>BIT 7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th></tr>
<tr><td>n+0
n+1</td><td colspan="8">Parameter Code = 8004h</td></tr>
<tr><td>n+2</td><td>DU</td><td>DS</td><td>TSD</td><td>ETC</td><td colspan="2">TMC</td><td>R</td><td>LP</td></tr>
<tr><td>n+3</td><td colspan="8">Parameter Length = 04h</td></tr>
<tr><td>n+4
|
n+7</td><td colspan="8">ECC Error Counter</td></tr>
</table>

Table 13-20: ECC Error Counter Log Parameters

Parameter Code The Parameter Code is set to 8004h.

DU A Disable Update (DU) bit set to 0 indicates that the Drive is free to update the counter.

A DU bit set to 1 indicates that the Drive shall not update the counter except in response to a LOG SELECT command that specifies a new value for the counter.

The initiator may use the LOG SELECT command to set or clear the DU bit.

The Drive will set the DU bit to 1 when the counter reaches its maximum value (FFFFFFFFh).

DS The Disable Save (DS) bit is set to 1 to indicate that the Drive does **not support saving** of this log parameter.

(Note: This bit can not be changed by the initiator)

TSD The Target Save Disable (TSD) bit is set to 1 to indicate that the Drive does not provide any Drive-defined method for saving of this log parameter.

(Note: This bit can not be changed by the initiator)

ETC An Enable Threshold Comparison (ETC) bit indicates whether comparison to the threshold value is performed or not.

The default value is 0. See the LOG SELECT command for further description.

TMC The Threshold Met Criteria (TMC) field is valid only if ETC bit is 1 and it selects one of four possible Threshold Met Criteria.

The default value is 11b. See the LOG SELECT command for further description.

LP The List Parameters (LP) bit is set to 0 to indicate that the parameter is a data counter.

(Note: This bit can not be changed by the initiator)

Parameter Length This field is set to 04h to indicate that the counter is 4 bytes wide.

ECC Error Counter This counter counts the number of blocks where the CRC check failed during tape read operations. These are incorrect blocks reported to be correct by the CRC check but identified as incorrect by ECC. When this occurs tape motions stops and hard read error is reported.

13.3.5. TapeAlert Page

The TapeAlert Page (page code 2Eh), has 64 log parameters. Each 5-byte parameter field holds a Boolean parameter value. If bit 0 of the Parameter Value byte is set go 1 the value is TRUE. The remaining 7 bits are reserved for future use and will always be set to 0.

Since the TapeAlert data is event based, the page control bits in the LOG SENSE command are not applicable, and will therefore be ignored by the drive.

BYTE	BIT 7	6	5	4	3	2	1	0
00	RESERVED		Page Code = 2Eh					
01	RESERVED							
02 03	Page Length = 0140h							
04 | 323	TapeAlert Log Parameters (64 x 5 bytes)							

Table 13-21: TapeAlert Page

Page Code The Page Code for this page is 2Eh.

Page Length This field is set to 0140h indicating that a list of 64 TapeAlert flags each of length 5 bytes follows.

TapeAlert Information Log Parameters

BYTE	BIT 7	6	5	4	3	2	1	0
5n-1 5n	Parameter Code = ***n***							
5n+1	DU	DS	TSD	ETC	TMC		R	LP
5n+2	Parameter Length = 01h							
5n+3	Value of TapeAlert Flag ***n***							

Table 13-22: TapeAlert Information Log Parameters

Parameter Code The Parameter Code for each TapeAlert flag field is set to ***n*** where n is the TapeAlert flag number. ***n*** is in the range (1..64). The different parameter fields are returned in ascending order of the parameter code.

DU A Disable Update (DU) bit set to 0 indicates that the Drive is free to update the TapeAlert flag.

DS The Disable Save (DS) bit is set to 1 to indicate that the Drive does not support saving of this log parameter.

TSD The Target Save Disable (TSD) bit is set to 0.

ETC The Enable Threshold Comparison (ETC) bit is set to 0 to indicate that no threshold comparison will take place.

TMC The Threshold Met Criteria (TMC) field is set to 0.

LP The List Parameters (LP) bit is set to 0 to indicate that the parameter is a data counter.

Parameter Length This field is set to 1 to indicate that the parameter field is one byte long.

Value of TapeAlert Flag Bit 0 of this byte is set to 0 when the flag is FALSE. Bit 0 of this byte is set to 1 when the flag is TRUE. Bit 1...7 are all reserved and are set to 0. Unsupported TapeAlert flags are all set to FALSE.

The following TapeAlert flags are supported:

Flag Number	Flag	Severity	Cause
Flag 3:	**Hard Error**	W	This flag is set to 1 for any unrecoverable read/write/positioning error, and is internally cleared when the media is ejected. (This flag is set as an explanation of the error in conjunction with one of the recovery action flags 4,5 or 6.)
Flag 4:	**Media**	C	This flag is set to 1 when the Media Management algorithm[1] detects a medium with severely degraded performance. The drive will monitor the media performance and maintain a media performance history log in the media header. The algorithm is executed each time the media header is updated (i.e. after a REWIND or LOAD/UNLOAD command). This flag is also set to 1 for any unrecoverable read/write/positioning error that is due to faulty media. The flag is internally cleared when the media is ejected.
Flag 5:	**Read Failure**	C	This flag is set to 1 for an unrecoverable read error where the diagnosis is uncertain and could either be faulty media or faulty drive hardware. The flag is internally cleared when the media is ejected.
Flag 6:	**Write Failure**	C	This flag is set to 1 for an unrecoverable write error where the diagnosis is uncertain and could either be faulty media or faulty drive hardware. The flag is internally cleared when the media is ejected.
Flag 20:	**Clean Now**	C	This flag is set to 1 when the tape drive detects that the head needs cleaning. The flag is internally cleared after a successful cleaning operation.
Flag 22:	**Expired Cleaning**	C	This flag is set to 1 when the drive detects that an inserted cleaning cartridge has been exhausted. The flag is internally cleared after a successful cleaning operation with a new cleaning cartridge.
Flag 31:	**Hardware B**	C	This flag is set to 1 when the drive fails in it's internal Power On Selftest (POST). The flag is only cleared when the drive power is turned off.

Table 13-23: Supported TapeAlert Flags (to be continued…)

[1] The Media Management algorithm is only executed on SLRtape140, SLRtape100, SLRtape75, SLRtape60 or SLRtape40 media.

Flag Number	Flag	Severity	Cause
Flag 39:	**Diagnostics Required**	W	This flag is set to 1 when the Media Management algorithm[1] detects a drive with a dead channel. The drive will monitor the channel performance and maintain a drive performance history log in the media header. The algorithm is executed each time the media header is updated (i.e. after a REWIND or LOAD/-UNLOAD command). Run extended diagnostics (e.g. Stand Alone Diagnostics (SAD) test or Send Diagnostics) to verify that the drive has a fault. The flag is internally cleared when the media is ejected.

Table 13-23: Supported TapeAlert Flags

Each flag will be cleared to zero in the following circumstances:

- At drive power on
- When the TapeAlert Log page is read.
- When specified corrective action has been taken (such as using a cleaning cartridge)
- On SCSI bus reset or Bus Device Reset Message
- On Log Select reset

NOTE:
When a flag is cleared by reading the TapeAlert Log page, the flag will not be set again until the error condition is removed (e.g. the specified corrective action has been taken). All other methods of clearing allow the flag to be set again.

[1] The Media Management algorithm is only executed on SLRtape140, SLRtape100, SLRtape75, SLRtape60 or SLRtape40 media.

13.3.6. Data Block Counters Page

BYTE	BIT 7	6	5	4	3	2	1	0
00	RESERVED		Page Code = 30h					
01	RESERVED							
02 03	Page Length = 0020h							
04 | 11	Logical Block Counter Log Parameters							
12 | 23	Write Media Block Counter Log Parameters							
24 | 35	Read Media Block Counter Log Parameters							

Table 13-24: Data Block Counters Page

Page Code The Page Code for this page is 30h.

Page Length This field is set to 0020h indicating that the page parameters occupy 32 bytes.

Logical Block Counter Log Parameters

BYTE	BIT 7	6	5	4	3	2	1	0
n+0 n+1	Parameter Code = 0000h							
n+2	DU	DS	TSD	ETC	TMC		R	LP
n+3	Parameter Length = 04h							
n+4 | n+7	Logical Data Block Counter							

Table 13-25: Logical Block Counter Log Parameters

Parameter Code The Parameter Code is set to 0000h.

DU A Disable Update (DU) bit set to 0 indicates that the Drive is free to update the counter.

A DU bit set to 1 indicates that the Drive shall not update the counter except in response to a LOG SELECT command that specifies a new value for the counter.

The initiator may use the LOG SELECT command to set or clear the DU bit.

The Drive will set the DU bit to 1 when the counter reaches its maximum value (FFFFFFFFh).

DS The Disable Save (DS) bit is set to 1 to indicate that the Drive does **not support saving** of this log parameter.

(Note: This bit can not be changed by the initiator)

TSD The Target Save Disable (TSD) bit is set to 1 to indicate that the Drive does not provide any Drive-defined method for saving of this log parameter.

(Note: This bit can not be changed by the initiator)

ETC An Enable Threshold Comparison (ETC) bit indicates whether comparison to the threshold value is performed or not.

The default value is 0. See the LOG SELECT command for further description.

TMC The Threshold Met Criteria (TMC) field is valid only if ETC bit is 1 and it selects one of four possible Threshold Met Criteria.

The default value is 11b. See the LOG SELECT command for further description.

LP The List Parameters (LP) bit is set to 0 to indicate that the parameter is a data counter.

(Note: This bit can not be changed by the initiator)

Parameter Length This field is set to 04h to indicate that the counter is 4 byte wide.

Logical Data Block Counter This counter counts the number of Logical Data Blocks transported via the SCSI-bus. Whenever a Logical Data Block is transported either to or from the host this counter is incremented by one. A variable block counts as one data block.

Write Media Block Counter Log Parameters

BYTE	BIT 7	6	5	4	3	2	1	0
n+0 n+1	Parameter Code = 0001h							
n+2	DU	DS	TSD	ETC	TMC		R	LP
n+3	Parameter Length = 08h							
n+4 | n+11	Write Media Blocks Counter							

Table 13-26: Write Media Blocks Counter Parameters

Parameter Code
The Parameter Code is set to 0001h.

DU
A Disable Update (DU) bit set to 0 indicates that the Drive is free to update the counter.

A DU bit set to 1 indicates that the Drive shall not update the counter except in response to a LOG SELECT command that specifies a new value for the counter.

The initiator may use the LOG SELECT command to set or clear the DU bit.

The Drive sets the DU bit to 1 when the counter reaches its maximum value (FFFFFFFFFFFFFFFFh).

DS
The Disable Save (DS) bit is set to 0 to indicate that the Drive does **support saving** of this log parameter.

(Note: This bit can not be changed by the initiator)

TSD
The Target Save Disable (TSD) bit is set to 0. The Drive will save this log parameter each time a cartridge is unloaded.

(Note: This bit can not be changed by the initiator)

ETC
An Enable Threshold Comparison (ETC) bit indicates whether comparison to the threshold value is performed or not.

The default value is 0. See the LOG SELECT command for further description.

TMC
The Threshold Met Criteria (TMC) field is valid only if ETC bit is 1 and it selects one of four possible Threshold Met Criteria.

The default value is 11b. See the LOG SELECT command for further description.

LP
The List Parameters (LP) bit is set to 0 to indicate that the parameter is a data counter.

(Note: This bit can not be changed by the initiator)

Parameter Length
This field is set to 08h to indicate that the counter is 8 bytes wide.

Write Media Blocks Counter
This counter counts the physical blocks, written to the media, during write operations. It is incremented by one on the detection of each new physical block. (The physical blocks are data blocks, control blocks, filler blocks, ECC blocks and tape marks.)

Read Media Block Counter Log Parameters

BYTE	BIT 7	6	5	4	3	2	1	0
n+0 n+1	Parameter Code = 0002h							
n+2	DU	DS	TSD	ETC	TMC		R	LP
n+3	Parameter Length = 08h							
n+4 | n+11	Read Media Blocks Counter							

Table 13-27: Read Media Block Counter Log Parameters

Parameter Code The Parameter Code is set to 0002h.

DU A Disable Update (DU) bit set to 0 indicates that the Drive is free to update the counter.

A DU bit set to 1 indicates that the Drive shall not update the counter except in response to a LOG SELECT command that specifies a new value for the counter.

The initiator may use the LOG SELECT command to set or clear the DU bit.

The Drive sets the DU bit to 1 when the counter reaches its maximum value (FFFFFFFFFFFFFFFFh).

DS The Disable Save (DS) bit is set to 0 to indicate that the Drive does **support saving** of this log parameter.

(Note: This bit can not be changed by the initiator)

TSD The Target Save Disable (TSD) bit is set to 0. The Drive will save this log parameter each time a cartridge is unloaded.

(Note: This bit can not be changed by the initiator)

ETC An Enable Threshold Comparison (ETC) bit indicates whether comparison to the threshold value is performed or not.

The default value is 0. See the LOG SELECT command for further description.

TMC The Threshold Met Criteria (TMC) field is valid only if ETC bit is 1 and it selects one of four possible Threshold Met Criteria.

The default value is 11b. See the LOG SELECT command for further description.

LP The List Parameters (LP) bit is set to 0 to indicate that the parameter is a data counter.

(Note: This bit can not be changed by the initiator)

Parameter Length This field is set to 08h to indicate that the counter is 8 bytes wide.

Read Media Blocks Counter This counter counts blocks, read from the media, during Read and Space operations. It is incremented by one on the detection of each new physical block. The counter will remain unchanged during Space reverse, Space EOD, Fast Space or on Locate operations.

13.3.7. Remaining Capacity Page

BYTE	BIT 7	6	5	4	3	2	1	0
00	RESERVED			Page Code = 31h				
01	RESERVED							
02 03	Page Length = 0020h							
04 | 11	Remaining Capacity Parameters - Partition 0[1]							
12 | 19	Remaining Capacity Parameters - Current Partition[1]							
20 | 27	Maximum Capacity Parameters - Partition 0[1]							
28 | 35	Maximum Capacity Parameters - Current Partition[1]							

Table 13-28: Remaining Capacity Page

Page Code The Page Code for this page is 31h.

Page Length This field is set to 0020h indicating that the page parameters occupy 32 bytes.

[1] The SLR60 and SLR75 drives will not distinguish between SLRtape60 and SLRtape75 when these are loaded into the drive. The drive will in both cases report Remaining Capacity as if a SLRtape60 was loaded until the drive has written or read one full track of data form BOT to EOT. From that point onwards, Remaining Capacity will be reported correctly also in the case an SLRtape75 is loaded

Remaining Capacity Parameters - Partition 0

BYTE	BIT 7	6	5	4	3	2	1	0
n+0 n+1	Parameter Code = 0001h							
n+2	DU	DS	TSD	ETC	TMC		R	LP
n+3	Parameter Length = 04h							
n+4 | n+7	Remaining Capacity Counter - Partition 0							

Table 13-29: Remaining Capacity Log Parameter code 01

Parameter Code The Parameter Code is set to 0001h.

DU The Disable Update (DU) bit will always be set to 0 to indicate that the Drive is always free to update the counter.

(Note: This bit can not be changed by the initiator)

DS The Disable Save (DS) bit is set to 1 to indicate that the Drive does **not support saving** of this log parameter.

(Note: This bit can not be changed by the initiator)

TSD The Target Save Disable (TSD) bit is set to 1 to indicate that the Drive does not provide any Drive-defined method for saving of this log parameter.

(Note: This bit can not be changed by the initiator)

ETC The Enable Threshold (ETC) bit is set to 0 to indicate that no threshold comparison will take place.

TMC The Threshold Met Criteria (TMC) field is valid only if ETC bit is 1 and it selects one of four possible Threshold Met Criteria.

The default value is 11b. See the LOG SELECT command for further description.

LP The List Parameters (LP) bit is set to 0 to indicate that the parameter is a data counter.

(Note: This bit can not be changed by the initiator)

Parameter Length This field is set to 04h to indicate that the counter is 4 bytes wide.

Remaining Capacity Counter - Partition 0

When the drive operates in write mode this counter counts/presents remaining physical native capacity of partition 0, scaled in KBytes. When the drive operates in read mode this counter reflects the potential amount of data stored from the current tape position to the end of the partition and not the actual remaining storage capacity of the partition. If the drive operates on another partition than partition 0, this counter will be equal to Maximum Capacity of partition 0.

Note that the capacity indicated is the capacity up to the *logical early warning* marker.

This counter is not designed for use as an absolute count of remaining capacity at any arbitrary moment, but as a means to calculate approximate fraction of tape usage during backup or restore operations.

Any attempt by initiator to alter this counters value will be ignored.

Note: The Remaining Capacity counter presents an approximate amount of native physical data which can be written to the current tape partition. This count can be related to logical user data only if the tape drive is used in an optimal way. A high number of underruns during write (due to a tape of poor quality, not favorable system settings, low host transfer rate and/or writing of a small amount of data per session) or excessive use of forced streaming might reduce the actual remaining capacity significantly. In addition, the counter does not reflect any impact of a possible use of data compression. The Remaining Capacity counter is controlled by processes on the tape side of the data buffer and is thus not fully synchronized with the data stream on the SCSI-bus.

Remaining Capacity Log Parameters - Current Partition

BYTE	BIT 7	6	5	4	3	2	1	0
n+0 n+1	Parameter Code = 0002h							
n+2	DU	DS	TSD	ETC	TMC		R	LP
n+3	Parameter Length = 04h							
n+4 | n+7	Remaining Capacity Counter - Current Partition							

Table 13-30: Remaining Capacity Log Parameter code 02

Parameter Code The Parameter Code is set to 0002h.

DU The Disable Update (DU) bit will always be set to 0 to indicate that the Drive is always free to update the counter.

(Note: This bit can not be changed by the initiator)

DS The Disable Save (DS) bit is set to 1 to indicate that the Drive does **not support saving** of this log parameter.

(Note: This bit can not be changed by the initiator)

TSD The Target Save Disable (TSD) bit is set to 1 to indicate that the Drive does not provide any Drive-defined method for saving of this log parameter.

(Note: This bit can not be changed by the initiator)

ETC The Enable Threshold (ETC) bit is set to 0 to indicate that no threshold comparison will take place.

TMC The Threshold Met Criteria (TMC) field is valid only if the ETC bit is set to 1 and it selects one of four possible Threshold Met Criteria.

The default value is 11b. See the LOG SELECT command for further description.

LP The List Parameters (LP) bit is set to 0 to indicate that the parameter is a data counter.

(Note: This bit can not be changed by the initiator)

Parameter Length This field is set to 04h to indicate that the counter is 4 bytes wide.

Remaining Capacity Counter - Current Partition

When the drive operates in write mode this counter counts/presents the remaining physical native capacity of the current (active) partition, scaled in KBytes. When the drive operates in read mode this counter will reflect the potential amount of data stored from the current tape position to the end of the partition and not the actual remaining storage capacity of the partition.

Note that the capacity indicated is the capacity up to the *logical early warning* marker.

This counter is not designed for use as an absolute count of remaining capacity at any arbitrary moment, but as a means to calculate the approximate fraction of tape usage during backup or restore operations.

Any attempt by the initiator to alter this counter will be ignored.

Notes:

❶ *The Remaining Capacity counter presents an approximate amount of native physical data which can be written to the current tape partition. This count can be related to logical user data only if the tape drive is used in an optimal way. A high number of underruns during write (due to a tape of poor quality, not favorable system settings, low host transfer rate and/or writing of a small amount of data per session) or excessive use of forced streaming might reduce the actual remaining capacity significantly. In addition, the counter does not reflect any impact of a possible use of data compression. The Remaining Capacity counter is controlled by processes on the tape of the data buffer and is thus not fully synchronized with the data stream on the SCSI-bus.*

❷ *The Current Partition number can be obtained from the Active Partition field of the Device Configuration Page using a MODE SENSE command. The number of additional partitions on the currently inserted tape can be obtained from the Additional Partitions Defined field of the Medium Partition Page using a MODE SENSE command.*

Maximum Capacity Log Parameters - Partition 0

BYTE	BIT 7	6	5	4	3	2	1	0
n+0 n+1	Parameter Code = 0003h							
n+2	DU	DS	TSD	ETC	TMC		R	LP
n+3	Parameter Length = 04h							
n+4 | n+7	Maximum Capacity Counter - Partition 0							

Table 13-31: Maximum Capacity Log Parameter code 03

Parameter Code The Parameter Code is set to 0003h.

DU The Disable Update (DU) bit will always be set to 0 to indicate that the Drive is always free to update the counter.

(Note: This bit can not be changed by the initiator)

DS The Disable Save (DS) bit is set to 1 to indicate that the Drive does **not support saving** of this log parameter.

(Note: This bit can not be changed by the initiator)

TSD The Target Save Disable (TSD) bit is set to 1 to indicate that the Drive does not provide any Drive-defined method for saving of this log parameter.

(Note: This bit can not be changed by the initiator)

ETC The Enable Threshold (ETC) bit is set to 0 to indicate that no threshold comparison will take place.

TMC The Threshold Met Criteria (TMC) field is valid only if ETC bit is 1 and it selects one of four possible Threshold Met Criteria.

The default value is 11b. See the LOG SELECT command for further description.

LP The List Parameters (LP) bit is set to 0 to indicate that the parameter is a data counter.

(Note: This bit can not be changed by the initiator)

Parameter Length This field is set to 04h to indicate that the counter is 4 bytes wide.

Maximum Capacity Counter - Partition 0 This counter presents an estimation of the maximum capacity of partition 0. This counter reflects corresponding value of Partition Size Descriptor in Mode Sense’s - Medium Partition Page, but the count here is scaled to kilobytes.

Any attempt by initiator to alter this counters accumulated, threshold or control-bytes values will be ignored.

Maximum Capacity Log Parameters - Current Partition.

BYTE	BIT 7	6	5	4	3	2	1	0
n+0 n+1	Parameter Code = 0004h							
n+2	DU	DS	TSD	ETC	TMC		R	LP
n+3	Parameter Length = 04h							
n+4 | n+7	Maximum Capacity Counter - Current Partition							

Table 13-32: Maximum Capacity Log Parameter code 04

Parameter Code The Parameter Code is set to 0004h.

DU The Disable Update (DU) bit will always be set to 0 to indicate that the Drive is always free to update the counter.

(Note: This bit can not be changed by the initiator)

DS The Disable Save (DS) bit is set to 1 to indicate that the Drive does **not support saving** of this log parameter.

(Note: This bit can not be changed by the initiator)

TSD The Target Save Disable (TSD) bit is set to 1 to indicate that the Drive does not provide any Drive-defined method for saving of this log parameter.

(Note: This bit can not be changed by the initiator)

ETC The Enable Threshold (ETC) bit is set to 0 to indicate that no threshold comparison will take place.

TMC The Threshold Met Criteria (TMC) field is valid only if the ETC bit is set to 1 and it selects one of four possible Threshold Met Criteria.

The default value is 11b. See the LOG SELECT command for further description.

LP The List Parameters (LP) bit is set to 0 to indicate that the parameter is a data counter.

(Note: This bit can not be changed by the initiator)

Parameter Length This field is set to 04h to indicate that the counter is 4 bytes wide.

Maximum Capacity Counter - Current Partition This counter presents an estimation of the maximum capacity of the current partition. This counter corresponds to the value of the Partition Size Descriptor of Active Partition in Mode Sense’s - Medium Partition Page, but the count here is scaled to kilobytes.

Any attempt by the Initiator to alter this counters accumulated, threshold or control-bytes value will be ignored.

(Note: The Current Partition number can be obtained from MODE SENSE - Device Configuration Page - see field Active Partition. The Number of additional partitions on the currently inserted tape can be obtained from MODE SENSE - Medium Partition Page - see field Additional Partitions Defined.)

13.3.8. Tape Mark Counters Page

BYTE	BIT 7	6	5	4	3	2	1	0
00	RESERVED			Page Code = 32h				
01	RESERVED							
02 03	Page Length = 0010h							
04 | 11	Filemark Counter Parameters							
12 | 19	Setmark Counter Parameters							

Table 13-33: Tape Mark Counters Page

Page Code The Page Code for this page is 32h.

Page Length This field is set to 0010h indicating that the page parameters occupy 16 bytes.

Filemark Counter Log Parameters

BYTE	BIT 7	6	5	4	3	2	1	0
n+0 n+1	Parameter Code = 0000h							
n+2	DU	DS	TSD	ETC	TMC		R	LP
n+3	Parameter Length = 04h							
n+4 | n+7	Filemark Counter							

Table 13-34: Filemark Counter Log Parameters

Parameter Code The Parameter Code is set to 0000h.

DU A Disable Update (DU) bit set to 0 indicates that the Drive is free to update the counter.

A DU bit set to 1 indicates that the Drive shall not update the counter except in response to a LOG SELECT command that specifies a new value for the counter.

The initiator may use the LOG SELECT command to set or clear the DU bit.

The Drive will set the DU bit to 1 when the counter reaches its maximum value (FFFFFFFFh).

DS The Disable Save (DS) bit is set to 1 to indicate that the Drive does **not support saving** of this log parameter.

(Note: This bit can not be changed by the initiator)

TSD
The Target Save Disable (TSD) bit is set to 1 to indicate that the Drive does not provide any Drive-defined method for saving of this log parameter.

(Note: This bit can not be changed by the initiator)

ETC
The Enable Threshold (ETC) bit is set to 0 to indicate that no threshold comparison will take place.

TMC
The Threshold Met Criteria (TMC) field is valid only if ETC bit is 1 and it selects one of four possible Threshold Met Criteria.

The default value is 11b. See the LOG SELECT command for further description.

LP
The List Parameters (LP) bit is set to 0 to indicate that the parameter is a data counter.

(Note: This bit can not be changed by the initiator)

Parameter Length
This field is set to 04h to indicate that the counter is 4 bytes wide.

Filemark Counter
This counter counts the number of filemarks received from or reported to the Initiator, and number of filemarks being spaced over on Initiators request (i.e. SCSI commands: Space over filemarks and Space over sequential filemarks) [1].

[1] The counter always counts up without regard to the direction of the space command.

Setmark Counter Log Parameters

BYTE	BIT 7	6	5	4	3	2	1	0
n+0 n+1	Parameter Code = 0001h							
n+2	DU	DS	TSD	ETC	TMC		R	LP
n+3	Parameter Length = 04h							
n+4 | n+7	Setmark Counter							

Table 13-35: Setmark Counter Log Parameters

Parameter Code The Parameter Code is set to 0001h.

DU A Disable Update (DU) bit set to 0 indicates that the Drive is free to update the counter.

A DU bit set to 1 indicates that the Drive shall not update the counter except in response to a LOG SELECT command that specifies a new value for the counter.

The initiator may use the LOG SELECT command to set or clear the DU bit.

The Drive will set the DU bit to 1 when the counter reaches its maximum value (FFFFFFFFh).

DS The Disable Save (DS) bit is set to 1 to indicate that the Drive does **not support saving** of this log parameter.

(Note: This bit can not be changed by the initiator)

TSD The Target Save Disable (TSD) bit is set to 1 to indicate that the Drive does not provide any Drive-defined method for saving of this log parameter.

(Note: This bit can not be changed by the initiator)

ETC An Enable Threshold Comparison (ETC) bit indicates whether comparison to the threshold value is performed or not.

The default value is 0. See the LOG SELECT command for further description.

TMC The Threshold Met Criteria (TMC) field is valid only if ETC bit is 1 and it selects one of four possible Threshold Met Criteria.

The default value is 11b. See the LOG SELECT command for further description.

LP The List Parameters (LP) bit is set to 0 to indicate that the parameter is a data counter.

(Note: This bit can not be changed by the initiator)

Parameter Length This field is set to 04h to indicate that the counter is 4 bytes wide.

Setmark Counter This counter counts the number of setmarks received from or reported to the Initiator, and the number of setmarks being spaced over on the Initiators request (using SPACE Over Setmarks command) [1].

[1] The counter always counts up without regard to the direction of the space command.

13.3.9. Head Cleaning Page

BYTE	BIT 7	6	5	4	3	2	1	0
00	RESERVED		Page Code = 33h					
01	RESERVED							
02 03	Page Length = 12h							
04 | 08	Clean Head Log Parameters							
9 | 15	Head Cleaning Time Log Parameters							
16 | 21	Cleaning Count Log Parameters							

Table 13-36: Head Cleaning Page

Page Code The Page Code for this page is 33h.

Page Length This field is set to 12h indicating that the page parameters occupy 18 bytes.

Clean Head Log Parameters

BYTE	BIT 7	6	5	4	3	2	1	0
n+0 n+1	Parameter Code = 0000h							
n+2	DU	DS	TSD	ETC	TMC		R	LP
n+3	Parameter Length = 01h							
n+4	RESERVED							Clean

Table 13-37: Clean Head Log Parameters

Parameter Code The Parameter Code is set to 0000h.

DU The Disable Update (DU) bit will always be set to 0 to indicate that the **Drive is always free to update the counter.**

(Note: This bit can not be changed by the initiator)

DS The Disable Save (DS) bit is set to 0 to indicate that the Drive does **support saving** of this log parameter.

(Note: This bit can not be changed by the initiator)

TSD The Target Save Disable (TSD) bit is set to 0. The Drive will save this log parameter each time the parameter value has been changed.

(Note: This bit can not be changed by the initiator)

ETC An Enable Threshold Comparison (ETC) bit is always 0 and indicates that the comparison will NOT be performed.

(Note: This bit can not be changed by the initiator)

TMC The Threshold Met Criteria (TMC) field is not valid as the ETC bit is 0 and can’t be changed from it’s default value 11b.

LP The List Parameters (LP) bit is set to 0 to indicate that the parameter is a data counter.

(Note: This bit can not be changed by the initiator)

Parameter Length This field is set to 01h to indicate that the counter is 1 bytes wide.

Clean The Clean bit is normally 0, but if the magnetic head of the Drive has to be cleaned the value of this field is changed to 1 [1].

Head Cleaning Time Log Parameters

BYTE	BIT 7	6	5	4	3	2	1	0
n+0 n+1	Parameter Code = 0001h							
n+2	DU	DS	TSD	ETC	TMC		R	LP
n+3	Parameter Length = 03h							
n+4 | n+6	Head Cleaning Time							

Table 13-38: Head Cleaning Time Log Parameters

Parameter Code The Parameter Code is set to 0001h.

DU The Disable Update (DU) bit will normally be set to 0 to indicate that the Drive is always free to update the counter. If the counter reaches its maximum value (FFFFFFh) the DU bit is set to 1 and cause the counter to retain its maximum value until a successful cleaning has been performed. When the cleaning is performed both the DU bit and counter are cleared.

DS The Disable Save (DS) bit is set to 0 to indicate that the Drive does **support saving** of this log parameter.

(Note: This bit can not be changed by the initiator)

TSD The Target Save Disable (TSD) bit is set to 0. The Drive will save this log parameter each time a cartridge is unloaded.

(Note: This bit can not be changed by the initiator)

ETC An Enable Threshold Comparison (ETC) bit indicates whether comparison to the threshold value is performed or not.

The default value is 0. See the LOG SELECT command for further description.

---

[1] The criteria for setting the Clean bit are poor read/write performance and when the tape has traveled more than a pre-set threshold since last cleaning.

TMC

The Threshold Met Criteria (TMC) field is valid only if ETC bit is 1 and it selects one of four possible Threshold Met Criteria.

The default value is 11b. See the LOG SELECT command for further description.

LP

The List Parameters (LP) bit is set to 0 to indicate that the parameter is a data counter.

(Note: This bit can not be changed by the initiator)

Parameter Length

This field is set to 03h to indicate that the counter is 3 bytes wide.

Head Cleaning Time Counter

The Head Cleaning Time indicates minutes of motion since last head cleaning.

Cleaning Count Log Parameters

BYTE	BIT 7	6	5	4	3	2	1	0
n+0 n+1	Parameter Code = 0002h							
n+2	DU	DS	TSD	ETC	TMC		R	LP
n+3	Parameter Length = 02h							
n+4 | n+5	Cumulative Cleaning Counter							

Table 13-39: Cleaning Count Log Parameters

Parameter Code The Parameter Code is set to 0002h.

DU The Disable Update (DU) bit will normally be set to 0 to indicate that the Drive is always free to update the counter. When the counter reaches its maximum values (FFFFh) the DU bit is set to 1 and cause the counter to retain its maximum value.

DS The Disable Save (DS) bit is set to 0 to indicate that the Drive does **support saving** of this log parameter.

(Note: This bit can not be changed by the initiator)

TSD The Target Save Disable (TSD) bit is set to 0. The Drive will save this log parameter each time a cartridge is unloaded.

(Note: This bit can not be changed by the initiator)

ETC An Enable Threshold Comparison (ETC) bit indicates whether comparison to the threshold value is performed or not.

The default value is 0. See the LOG SELECT command for further description.

TMC The Threshold Met Criteria (TMC) field is valid only if ETC bit is 1 and it selects one of four possible Threshold Met Criteria.

The default value is 11b. See the LOG SELECT command for further description.

LP The List Parameters (LP) bit is set to 0 to indicate that the parameter is a data counter.

(Note: This bit can not be changed by the initiator)

Parameter Length This field is set to 02h to indicate that the counter is 2 bytes wide.

Cumulative Cleaning Counter The Cumulative Cleaning Counter counts number of successfully performed head cleanings.

13.3.10. Drive Page

BYTE	BIT 7	6	5	4	3	2	1	0
00	RESERVED		Page Code = 34h					
01	RESERVED							
02 03	Page Length = 0Eh							
04 | 10	Total Power On Time Parameters							
11 | 17	Cartridge Load Counter Parameters							

Table 13-40: Drive Page

Page Code The Page Code for this page is 34h.

Page Length This field is always set to 0Eh indicating that the page parameters occupy 14 bytes.

Total Power On Time Parameters

BYTE	BIT 7	6	5	4	3	2	1	0
n+0 n+1	Parameter Code = 0002h							
n+2	DU	DS	TSD	ETC	TMC		R	LP
n+3	Parameter Length = 03h							
n+4 | n+6	Total Power On Time							

Table 13-41: Total Power On Time Parameters

Parameter Code The Parameter Code is set to 0002h.

DU The Disable Update (DU) bit will normally be set to 0 to indicate that the Drive is always free to update the counter. If the counter reaches its maximum value (FFFFFFh) the DU bit is set to 1 and cause the counter to retain its maximum value.

(Note: This bit can not be changed by the initiator)

DS The Disable Save (DS) bit is set to 0 to indicate that the Drive does **support saving** of this log parameter.

(Note: This bit can not be changed by the initiator)

TSD The Target Save Disable (TSD) bit is set to 0. The Drive will save this log parameter each time a cartridge is unloaded.

(Note: This bit can not be changed by the initiator)

ETC An Enable Threshold Comparison (ETC) bit indicates whether comparison to the threshold value is performed or not.

The default value is 0. See the LOG SELECT command for further description.

TMC The Threshold Met Criteria (TMC) field is valid only if ETC bit is 1 and it selects one of four possible Threshold Met Criteria.

The default value is 11b. See the LOG SELECT command for further description.

LP The List Parameters (LP) bit is set to 0 to indicate that the parameter is a data counter.

(Note: This bit can not be changed by the initiator)

Parameter Length This field is set to 03h to indicate that the counter is 3 bytes wide.

Total Power On Time The Total Power On Time counter accumulates the total amount of minutes the Drive has been on [1].

Any attempt by initiator to alter this counters value will be ignored.

[1] The range of this counter, 0 to 16777215 minutes, corresponds to a period from 0 to about 31 years.

Cartridge Load Counter Parameters

BYTE	BIT 7	6	5	4	3	2	1	0
n+0 n+1	Parameter Code = 0003h							
n+2	DU	DS	TSD	ETC	TMC		R	LP
n+3	Parameter Length = 03h							
n+4 | n+6	Cartridge Load Counter							

Table 13-42: Cartridge Load Counter Parameters

Parameter Code — The Parameter Code is set to 0003h.

DU — The Disable Update (DU) bit will normally be set to 0 to indicate that the Drive is always free to update the counter. If the counter reaches its maximum value (FFFFFFh) the DU bit is set to 1 and cause the counter to retain its maximum value.

(Note: This bit can not be changed by the initiator)

DS — The Disable Save (DS) bit is set to 0 to indicate that the Drive does **support saving** of this log parameter.

(Note: This bit can not be changed by the initiator)

TSD — The Target Save Disable (TSD) bit is set to 0. The Drive will save this log parameter each time a cartridge is unloaded.

(Note: This bit can not be changed by the initiator)

ETC — An Enable Threshold Comparison (ETC) bit indicates whether comparison to the threshold value is performed or not.

The default value is 0. See the LOG SELECT command for further description.

TMC — The Threshold Met Criteria (TMC) field is valid only if ETC bit is 1 and it selects one of four possible Threshold Met Criteria.

The default value is 11b. See the LOG SELECT command for further description.

LP — The List Parameters (LP) bit is set to 0 to indicate that the parameter is a data counter.

(Note: This bit can not be changed by the initiator)

Parameter Length — This field is set to 03h to indicate that the counter is 3 bytes wide.

Cartridge Load Counter — The Cartridge Load Counter increments each time a new cartridge is physically loaded in the Drive.

Any attempt by initiator to alter this counters value will be ignored

13.3.11. Servo Page [1]

BYTE	BIT 7	6	5	4	3	2	1	0
00	RESERVED			Page Code = 35h				
01	RESERVED							
02 03	Page Length = 0028h							
04 | 09	Servo Lock Retry Log Parameters							
10 | 15	Servo Track Seek Log Parameters							
16 | 21	Write Servo Lock Lost Log Parameters							
22 | 29	Write Servo Dropout Log Parameters							
30 | 35	Read Servo Lock Lost Log Parameters							
36 | 43	Read Servo Dropout Log Parameters							

Table 13-43: Servo Page

Page Code The Page Code for this page is 35h.

Page Length This field is set to 0028h indicating that the page parameters occupy 40 bytes.

[1] This page is relevant for servo based media only (SLRtape140, SLRtape100, SLRtape75, SLRtape60, SLRtape50, SLRtape40, SLRtape7 and SLRtape24). The parameters of this page do not contain any valid information relating to other media.

Servo Lock Retry Log Parameters

BYTE	BIT 7	6	5	4	3	2	1	0
n+0 n+1	Parameter Code = 0000h							
n+2	DU	DS	TSD	ETC	TMC		R	LP
n+3	Parameter Length = 02h							
n+4 n+5	Servo Lock Retry Counter							

Table 13-44: Servo Lock Retry Log Parameters

Parameter Code The Parameter Code is set to 0000h.

DU A Disable Update (DU) bit set to 0 indicates that the Drive is free to update the counter.

A DU bit set to 1 indicates that the Drive shall not update the counter except in response to a LOG SELECT command that specifies a new value for the counter.

The initiator may use the LOG SELECT command to set or clear the DU bit.

The Drive will set the DU bit to 1 when the counter reaches its maximum value (FFFFh).

DS The Disable Save (DS) bit is set to 1 to indicate that the Drive does **not support saving** of this log parameter.

(Note: This bit can not be changed by the initiator)

TSD The Target Save Disable (TSD) bit is set to 1 to indicate that the Drive does not provide any Drive-defined method for saving of this log parameter.

(Note: This bit can not be changed by the initiator)

ETC An Enable Threshold Comparison (ETC) bit indicates whether comparison to the threshold value is performed or not.

The default value is 0. See the LOG SELECT command for further description.

TMC The Threshold Met Criteria (TMC) field is valid only if ETC bit is 1 and it selects one of four possible Threshold Met Criteria.

The default value is 11b. See the LOG SELECT command for further description.

LP The List Parameters (LP) bit is set to 0 to indicate that the parameter is a data counter.

(Note: This bit can not be changed by the initiator)

Parameter Length This field is set to 02h.

Servo Lock Retry Counter The Servo Lock Retry Counter is incremented when the Drive performs retry on a track seek operation. (The tape stops, moves back and starts to move again.).

Servo Track Seek Log Parameters

BYTE	BIT 7	6	5	4	3	2	1	0
n+0 n+1	Parameter Code = 0001h							
n+2	DU	DS	TSD	ETC	TMC		R	LP
n+3	Parameter Length = 02h							
n+4 n+5	Servo Track Seek Counter							

Table 13-45: Servo Track Seek Log Parameters

Parameter Code The Parameter Code is set to 0001h.

DU A Disable Update (DU) bit set to 0 indicates that the Drive is free to update the counter.

A DU bit set to 1 indicates that the Drive shall not update the counter except in response to a LOG SELECT command that specifies a new value for the counter.

The initiator may use the LOG SELECT command to set or clear the DU bit.

The Drive will set the DU bit to 1 when the counter reaches its maximum value (FFFFh).

DS The Disable Save (DS) bit is set to 1 to indicate that the Drive does **not support saving** of this log parameter.

(Note: This bit can not be changed by the initiator)

TSD The Target Save Disable (TSD) bit is set to 1 to indicate that the Drive does not provide any Drive-defined method for saving of this log parameter.

(Note: This bit can not be changed by the initiator)

ETC An Enable Threshold Comparison (ETC) bit indicates whether comparison to the threshold value is performed or not.

The default value is 0. See the LOG SELECT command for further description.

TMC The Threshold Met Criteria (TMC) field is valid only if ETC bit is 1 and it selects one of four possible Threshold Met Criteria.

The default value is 11b. See the LOG SELECT command for further description.

LP The List Parameters (LP) bit is set to 0 to indicate that the parameter is a data counter.

(Note: This bit can not be changed by the initiator)

Parameter Length This field is set to 02h.

Servo Track Seek Counter The Servo Track Seek Counter is incremented for each Track Seek. The track seek occurs each time the tape starts movement due to read or write operation.

Write Servo Lock Lost Log Parameters

BYTE	BIT 7	6	5	4	3	2	1	0
n+0 n+1	Parameter Code = 0002h							
n+2	DU	DS	TSD	ETC	TMC		R	LP
n+3	Parameter Length = 02h							
n+4 n+5	Write Servo Lock Lost Counter							

Table 13-46: Write Servo Lock Lost Counter Log Parameters

Parameter Code The Parameter Code is set to 0002h.

DU A Disable Update (DU) bit set to 0 indicates that the Drive is free to update the counter.

A DU bit set to 1 indicates that the Drive shall not update the counter except in response to a LOG SELECT command that specifies a new value for the counter.

The initiator may use the LOG SELECT command to set or clear the DU bit.

The Drive will set the DU bit to 1 when the counter reaches its maximum value (FFFFh).

DS The Disable Save (DS) bit is set to 1 to indicate that the Drive does **not support saving** of this log parameter.

(Note: This bit can not be changed by the initiator)

TSD The Target Save Disable (TSD) bit is set to 1 to indicate that the Drive does not provide any Drive-defined method for saving of this log parameter.

(Note: This bit can not be changed by the initiator)

ETC An Enable Threshold Comparison (ETC) bit indicates whether comparison to the threshold value is performed or not.

The default value is 0. See the LOG SELECT command for further description.

TMC The Threshold Met Criteria (TMC) field is valid only if ETC bit is 1 and it selects one of four possible Threshold Met Criteria.

The default value is 11b. See the LOG SELECT command for further description.

LP The List Parameters (LP) bit is set to 0 to indicate that the parameter is a data counter.

(Note: This bit can not be changed by the initiator)

Parameter Length This field is set to 02h.

Write Servo Lock Lost Counter The Servo Lock Lost Counter is incremented when the head servo has lost servo lock during write operation. The servo lock is considered to be lost if the tracking error exceeds allowed maximum value (This can for example happen, when the Drive is exposed to an external mechanical shock).

Write Servo Dropout Log Parameters

BYTE	BIT 7	6	5	4	3	2	1	0
n+0 n+1	Parameter Code = 0003h							
n+2	DU	DS	TSD	ETC	TMC		R	LP
n+3	Parameter Length = 04h							
n+4 | n+7	Write Servo Dropouts Counter							

Table 13-47: Write Servo Dropout Log Parameters

Parameter Code

The Parameter Code is set to 0003h.

DU

A Disable Update (DU) bit set to 0 indicates that the Drive is free to update the counter.

A DU bit set to 1 indicates that the Drive shall not update the counter except in response to a LOG SELECT command that specifies a new value for the counter.

The initiator may use the LOG SELECT command to set or clear the DU bit.

The Drive will set the DU bit to 1 when the counter reaches its maximum value (FFFFFFFFh).

DS

The Disable Save (DS) bit is set to 1 to indicate that the Drive does **not support saving** of this log parameter.

(Note: This bit can not be changed by the initiator)

TSD

The Target Save Disable (TSD) bit is set to 1 to indicate that the Drive does not provide any Drive-defined method for saving of this log parameter.

(Note: This bit can not be changed by the initiator)

ETC

An Enable Threshold Comparison (ETC) bit indicates whether comparison to the threshold value is performed or not.

The default value is 0. See the LOG SELECT command for further description.

TMC

The Threshold Met Criteria (TMC) field is valid only if ETC bit is 1 and it selects one of four possible Threshold Met Criteria.

The default value is 11b. See the LOG SELECT command for further description.

LP

The List Parameters (LP) bit is set to 0 to indicate that the parameter is a data counter.

(Note: This bit can not be changed by the initiator)

Parameter Length

This field is set to 04h.

Write Servo Dropout Counter

The Write Servo Dropout Counter is incremented on each two-channels dropout detection. A dropout may be caused by physical defect on the tape. The dropout has to be detected by both read heads, currently used for servo tracking, simultaneously, to effect Drive operation (and be counted here).

When a two-channel dropout is detected on a servo track during write operation, the write current is switched off to avoid writing over data on neighboring tracks.

Read Servo Lock Lost Log Parameters

BYTE	BIT 7	6	5	4	3	2	1	0
n+0 n+1	Parameter Code = 0004h							
n+2	DU	DS	TSD	ETC	TMC		R	LP
n+3	Parameter Length = 02h							
n+4 n+5	Read Servo Lock Lost Counter							

Table 13-48: Read Servo Lock Lost Counter Log Parameters

Parameter Code The Parameter Code is set to 0004h.

DU A Disable Update (DU) bit set to 0 indicates that the Drive is free to update the counter.

A DU bit set to 1 indicates that the Drive shall not update the counter except in response to a LOG SELECT command that specifies a new value for the counter.

The initiator may use the LOG SELECT command to set or clear the DU bit.

The Drive will set the DU bit to 1 when the counter reaches its maximum value (FFFFh).

DS The Disable Save (DS) bit is set to 1 to indicate that the Drive does **not support saving** of this log parameter.

(Note: This bit can not be changed by the initiator)

TSD The Target Save Disable (TSD) bit is set to 1 to indicate that the Drive does not provide any Drive-defined method for saving of this log parameter.

(Note: This bit can not be changed by the initiator)

ETC An Enable Threshold Comparison (ETC) bit indicates whether comparison to the threshold value is performed or not.

The default value is 0. See the LOG SELECT command for further description.

TMC The Threshold Met Criteria (TMC) field is valid only if ETC bit is 1 and it selects one of four possible Threshold Met Criteria.

The default value is 11b. See the LOG SELECT command for further description.

LP The List Parameters (LP) bit is set to 0 to indicate that the parameter is a data counter.

(Note: This bit can not be changed by the initiator)

Parameter Length This field is set to 02h.

Read Servo Lock Lost Counter The Read Servo Lock Lost Counter is incremented when the head servo has lost servo lock during read operation. The servo lock is considered to be lost if the tracking error exceeds allowed maximum value (This can for example happen, when the Drive is exposed to an external mechanical shock).

Read Servo Dropout Log Parameters

BYTE	BIT 7	6	5	4	3	2	1	0
n+0 n+1	Parameter Code = 0005h							
n+2	DU	DS	TSD	ETC	TMC		R	LP
n+3	Parameter Length = 04h							
n+4 | n+7	Read Servo Dropouts Counter							

Table 13-49: Read Servo Dropout Log Parameters

Parameter Code The Parameter Code is set to 0005h.

DU A Disable Update (DU) bit set to 0 indicates that the Drive is free to update the counter.

A DU bit set to 1 indicates that the Drive shall not update the counter except in response to a LOG SELECT command that specifies a new value for the counter.

The initiator may use the LOG SELECT command to set or clear the DU bit.

The Drive will set the DU bit to 1 when the counter reaches its maximum value (FFFFFFFFh).

DS The Disable Save (DS) bit is set to 1 to indicate that the Drive does **not support saving** of this log parameter.

(Note: This bit can not be changed by the initiator)

TSD The Target Save Disable (TSD) bit is set to 1 to indicate that the Drive does not provide any Drive-defined method for saving of this log parameter.

(Note: This bit can not be changed by the initiator)

ETC An Enable Threshold Comparison (ETC) bit indicates whether comparison to the threshold value is performed or not.

The default value is 0. See the LOG SELECT command for further description.

TMC The Threshold Met Criteria (TMC) field is valid only if ETC bit is 1 and it selects one of four possible Threshold Met Criteria.

The default value is 11b. See the LOG SELECT command for further description.

LP The List Parameters (LP) bit is set to 0 to indicate that the parameter is a data counter.

(Note: This bit can not be changed by the initiator)

Parameter Length This field is set to 04h.

Read Servo Dropout Counter The Read Servo Dropout Counter is incremented on each two-channels dropout detection during read. A dropout may be caused by physical defect on the tape. The dropout has to be detected by both read heads, currently used for servo tracking, simultaneously.

13.3.12. Track Number Page

BYTE	BIT 7	6	5	4	3	2	1	0
00	RESERVED		Page Code = 36h					
01	RESERVED							
02 03	Page Length = 0006h							
04 05	Parameter Code = 0000h							
06	DU	DS	TSD	ETC	TMC		R	LP
07	Parameter Length = 02h							
08 09	Track Number							

Table 13-50: Track Number Page

Page Code The Page Code for this page is 36h.

Page Length This field is set to 0006h indicating that the page parameter occupies 6 bytes.

Parameter Code The Parameter Code is set to 0000h.

DU The Disable Update (DU) bit will always be set to 0 to indicate that the Drive is always free to update the counter.

(Note: This bit can not be changed by the initiator)

DS The Disable Save (DS) bit is set to 1 to indicate that the Drive does **not support saving** of this log parameter.

(Note: This bit can not be changed by the initiator)

TSD The Target Save Disable (TSD) bit is set to 1 to indicate that the Drive does not provide any Drive-defined method for saving of this log parameter. *(Note: This bit can not be changed by the initiator)*

ETC An Enable Threshold Comparison (ETC) bit is always 0 and indicates that the comparison will NOT be performed.

(Note: This bit can not be changed by the initiator)

TMC The Threshold Met Criteria (TMC) field is not valid as the ETC bit is 0 and can't be changed from it's default value 11b.

LP The List Parameters (LP) bit is set to 0 to indicate that the parameter is a data counter. *(Note: This bit can not be changed by the initiator)*

Parameter Length This field is set to 02h to indicate that the counter is 2 bytes wide.

Track Number This two bytes indicates current position of the read/write head. The position is reported by indicating the current track or track set number (depending on the tape format in use).

13.3.13. Cartridge Usage Page

BYTE	BIT 7	6	5	4	3	2	1	0
00	RESERVED		Page Code = 37h					
01	RESERVED							
02 03	Page Length = 36h							
04 | 17	Cartridge Serial Number Log Parameters							
18 | 25	Cartridge Load Counter Log Parameters							
26 | 33	Cartridge BOT Pass Counter Log Parameters							
34 | 41	Cartridge EOT Pass Counter Log Parameters							
42 | 49	Cartridge Write Pass Counter Log Parameters							
50 | 57	Cartridge Motion Time Log Parameters							

Table 13-51: Cartridge Usage Page

Page Code The Page Code for this page is 37h.

Page Length This field is always set to 36h indicating that the page parameters occupy 54 bytes.

Cartridge Serial Number Parameters

BYTE	BIT 7	6	5	4	3	2	1	0
n+0 n+1	Parameter Code = 0001h							
n+2	DU	DS	TSD	ETC	TMC		LBIN	LP
n+3	Parameter Length = 0Ah							
n+4 | n+13	Cartridge Serial Number							

Table 13-52: Cartridge Serial Number Parameters

Parameter Code The Parameter Code is set to 0001h.

DU The Disable Update (DU) bit is not defined for List Parameters (indicated by the LP bit) and is set to 0.

(Note: This bit can not be changed by the initiator)

DS The Disable Save (DS) bit is set to 1 to indicate that the Drive does **not support saving** of this log parameter.

(Note: This bit can not be changed by the initiator)

TSD The Target Save Disable (TSD) bit is set to 0. The Cartridge Serial Number is saved on the medium but will never change.

(Note: This bit can not be changed by the initiator)

ETC The Enable Threshold Comparison (ETC) bit is not defined for List Parameters (indicated by the LP bit) and is set to 0.

(Note: This bit can not be changed by the initiator)

TMC The Threshold Met Criteria (TMC) field is not defined for List Parameters (indicated by the LP bit) and is set to 0.

(Note: This bit can not be changed by the initiator)

LBIN The LBIN bit is set to 0 to indicate that the List Parameter is a string of ASCII characters.

(Note: This bit can not be changed by the initiator)

LP The List Parameters (LP) bit is set to 1 to indicate that the parameter is a List Parameter.

(Note: This bit can not be changed by the initiator)

Parameter Length This field is set to 0Ah to indicate that the string is 10 bytes long.

Cartridge Serial Number The Cartridge Serial Number of the current inserted cartridge represented by ASCII characters. The string is not terminated by a null character. “ UNKNOWN “ is returned if no cartridge is inserted or the serial number is unavailable. The Cartridge Serial Number is also available in Mode Sense.

Any attempt by initiator to alter this List Parameter will be ignored.

Cartridge Load Counter Parameters

BYTE	BIT 7	6	5	4	3	2	1	0
n+0 n+1	Parameter Code = 0002h							
n+2	DU	DS	TSD	ETC	TMC		R	LP
n+3	Parameter Length = 04h							
n+4 | n+7	Cartridge Load Counter							

Table 13-53: Cartridge Load Counter Parameters

Parameter Code The Parameter Code is set to 0002h.

DU The Disable Update (DU) bit will normally be set to 0 to indicate that the Drive is always free to update the counter. If the counter reaches its maximum value (FFFFFFFFh) the DU bit is set to 1 and cause the counter to retain its maximum value.

(Note: This bit can not be changed by the initiator)

DS The Disable Save (DS) bit is set to 1 to indicate that the Drive does **not support saving** of this log parameter in response to a LOG SELECT or LOG SENSE command with an SP bit of 1.

(Note: This bit can not be changed by the initiator)

TSD The Target Save Disable (TSD) bit is set to 0. The Drive will save this log parameter on the medium each time the media header is updated, except when SLRtape50, SLR32, SLRtape24, SLR5 or DC9250 type medium is used. Note that the media header is only updated after write type operations. When only read type operations are performed the media header will not be updated and the new counter value will not be saved.

(Note: This bit can not be changed by the initiator)

ETC An Enable Threshold Comparison (ETC) bit indicates whether comparison to the threshold value is performed or not.

The default value is 0. See the LOG SELECT command for further description.

TMC The Threshold Met Criteria (TMC) field is valid only if ETC bit is 1 and it selects one of four possible Threshold Met Criteria.

The default value is 11b. See the LOG SELECT command for further description.

LP The List Parameters (LP) bit is set to 0 to indicate that the parameter is a data counter.

(Note: This bit can not be changed by the initiator)

Parameter Length This field is set to 04h to indicate that the counter is 4 bytes wide.

Cartridge Load Counter

The Cartridge Load Counter is incremented each time this cartridge is physically loaded in a Drive. This counter is saved on the medium and indicates how many times this cartridge is loaded by any Drive. Note, the Cartridge Load Counter in the Drive Page is saved in the Drive and indicates how many times a Drive has loaded any cartridge.

Any attempt by initiator to alter this counter value will be ignored

Cartridge BOT Pass Counter Log Parameters

BYTE	BIT 7	6	5	4	3	2	1	0
n+0 n+1	Parameter Code = 0003h							
n+2	DU	DS	TSD	ETC	TMC		R	LP
n+3	Parameter Length = 04h							
n+4 | n+7	Cartridge BOT Pass Counter							

Table 13-54: Cartridge BOT Pass Counter Log Parameters

Parameter Code The Parameter Code is set to 0003h.

DU The Disable Update (DU) bit will normally be set to 0 to indicate that the Drive is always free to update the counter. If the counter reaches its maximum value (FFFFFFFFh) the DU bit is set to 1 and cause the counter to retain its maximum value.

(Note: This bit can not be changed by the initiator)

DS The Disable Save (DS) bit is set to 1 to indicate that the Drive does **not support saving** of this log parameter in response to a LOG SELECT or LOG SENSE command with an SP bit of 1.

(Note: This bit can not be changed by the initiator)

TSD The Target Save Disable (TSD) bit is set to 0. The Drive will save this log parameter on the medium each time the media header is updated, except when SLRtape50, SLR32, SLRtape24, SLR5 or DC9250 type medium is used. Note that the media header is only updated after write type operations. When only read type operations are performed the media header will not be updated and the new counter value will not be saved. Note that this counter may be incremented during the media header update operation and this increment will not be saved on the medium.

(Note: This bit can not be changed by the initiator)

ETC An Enable Threshold Comparison (ETC) bit indicates whether comparison to the threshold value is performed or not.

The default value is 0. See the LOG SELECT command for further description.

TMC The Threshold Met Criteria (TMC) field is valid only if ETC bit is 1 and it selects one of four possible Threshold Met Criteria.

The default value is 11b. See the LOG SELECT command for further description.

LP The List Parameters (LP) bit is set to 0 to indicate that the parameter is a data counter.

(Note: This bit can not be changed by the initiator)

Parameter Length This field is set to 04h to indicate that the counter is 4 bytes wide.

Cartridge BOT Pass Counter The Cartridge BOT Pass Counter is incremented each time the Load Point (LP) tape marker is passed in forward direction. The counter is normally incremented by one for each track turn operation at BOT, incremented by one or two for each physically load operation and incremented by two for each media header update.

Any attempt by initiator to alter this counter value will be ignored

Cartridge EOT Pass Counter Log Parameters

BYTE	BIT 7	6	5	4	3	2	1	0
n+0 n+1	Parameter Code = 0004h							
n+2	DU	DS	TSD	ETC	TMC		R	LP
n+3	Parameter Length = 04h							
n+4 | n+7	Cartridge EOT Pass Counter							

Table 13-55: Cartridge EOT Pass Counter Log Parameters

Parameter Code
The Parameter Code is set to 0004h.

DU
The Disable Update (DU) bit will normally be set to 0 to indicate that the Drive is always free to update the counter. If the counter reaches its maximum value (FFFFFFFFh) the DU bit is set to 1 and cause the counter to retain its maximum value.

(Note: This bit can not be changed by the initiator)

DS
The Disable Save (DS) bit is set to 1 to indicate that the Drive does **not support saving** of this log parameter in response to a LOG SELECT or LOG SENSE command with an SP bit of 1.

(Note: This bit can not be changed by the initiator)

TSD
The Target Save Disable (TSD) bit is set to 0. The Drive will save this log parameter on the medium each time the media header is updated, except when SLRtape50, SLR32, SLRtape24, SLR5 or DC9250 type medium is used. Note that the media header is only updated after write type operations. When only read type operations are performed the media header will not be updated and the new counter value will not be saved.

(Note: This bit can not be changed by the initiator)

ETC
An Enable Threshold Comparison (ETC) bit indicates whether comparison to the threshold value is performed or not.

The default value is 0. See the LOG SELECT command for further description.

TMC
The Threshold Met Criteria (TMC) field is valid only if ETC bit is 1 and it selects one of four possible Threshold Met Criteria.

The default value is 11b. See the LOG SELECT command for further description.

LP
The List Parameters (LP) bit is set to 0 to indicate that the parameter is a data counter.

(Note: This bit can not be changed by the initiator)

Parameter Length
This field is set to 04h to indicate that the counter is 4 bytes wide.

Cartridge EOT Pass Counter
The Cartridge EOT Pass Counter is incremented each time the Early Warning (EW) tape marker is passed in reverse direction. The counter is normally incremented by 1 for each track turn operation at EOT.

Any attempt by initiator to alter this counter value will be ignored

Cartridge Write Pass Counter Log Parameters

BYTE	BIT 7	6	5	4	3	2	1	0
n+0 n+1	Parameter Code = 0005h							
n+2	DU	DS	TSD	ETC	TMC		LBIN	LP
n+3	Parameter Length = 04h							
n+4 | n+7	Cartridge Write Pass Counter							

Table 13-56: Cartridge Write Pass Counter Log Parameters

Parameter Code The Parameter Code is set to 0005h.

DU The Disable Update (DU) bit is not defined for List Parameters (indicated by the LP bit) and is set to 0.

(Note: This bit can not be changed by the initiator)

DS The Disable Save (DS) bit is set to 1 to indicate that the Drive does **not support saving** of this log parameter in response to a LOG SELECT or LOG SENSE command with an SP bit of 1.

(Note: This bit can not be changed by the initiator)

TSD The Target Save Disable (TSD) bit is set to 0. The Drive will save this list parameter on the medium for each write operation.

(Note: This bit can not be changed by the initiator)

ETC The Enable Threshold Comparison (ETC) bit is not defined for List Parameters (indicated by the LP bit) and is set to 0.

(Note: This bit can not be changed by the initiator)

TMC The Threshold Met Criteria (TMC) field is not defined for List Parameters (indicated by the LP bit) and is set to 0.

(Note: This bit can not be changed by the initiator)

LBIN The LBIN bit is set to 1 to indicate that the List Parameter contains binary information.

(Note: This bit can not be changed by the initiator)

LP The List Parameters (LP) bit is set to 1 to indicate that the parameter is a List Parameter.

(Note: This bit can not be changed by the initiator)

Parameter Length This field is set to 04h to indicate that the counter is 4 bytes wide.

Cartridge Write Pass Counter The Write Pass Counter is incremented each time the medium is written from BOP. Each partition has a separate Write Pass Counter and this page will return the counter of the current partition.

Any attempt by initiator to alter this parameter value will be ignored.

Cartridge Motion Time Log Parameters

BYTE	BIT 7	6	5	4	3	2	1	0
n+0 n+1	Parameter Code = 0006h							
n+2	DU	DS	TSD	ETC	TMC		R	LP
n+3	Parameter Length = 04h							
n+4 | n+7	Cartridge Motion Time							

Table 13-57: Cartridge Motion Time Log Parameters

Parameter Code The Parameter Code is set to 0006h.

DU The Disable Update (DU) bit will normally be set to 0 to indicate that the Drive is always free to update the counter. If the counter reaches its maximum value (FFFFFFFFh) the DU bit is set to 1 and cause the counter to retain its maximum value.

(Note: This bit can not be changed by the initiator)

DS The Disable Save (DS) bit is set to 1 to indicate that the Drive does **not support saving** of this log parameter in response to a LOG SELECT or LOG SENSE command with an SP bit of 1.

(Note: This bit can not be changed by the initiator)

TSD The Target Save Disable (TSD) bit is set to 0. The Drive will save this log parameter on the medium each time the media header is updated, except when SLRtape50, SLR32, SLRtape24, SLR5 or DC9250 type medium is used. Note that the media header is only updated after write type operations. When only read type operations are performed the media header will not be updated and the new counter value will not be saved.

(Note: This bit can not be changed by the initiator)

ETC An Enable Threshold Comparison (ETC) bit indicates whether comparison to the threshold value is performed or not.

The default value is 0. See the LOG SELECT command for further description.

TMC The Threshold Met Criteria (TMC) field is valid only if ETC bit is 1 and it selects one of four possible Threshold Met Criteria.

The default value is 11b. See the LOG SELECT command for further description.

LP The List Parameters (LP) bit is set to 0 to indicate that the parameter is a data counter.

(Note: This bit can not be changed by the initiator)

Parameter Length This field is set to 04h to indicate that the counter is 4 bytes wide.

Cartridge Motion Time The Cartridge Motion Time is incremented by 1 for each minute the cartridge has been in physical motion.

Any attempt by initiator to alter this counter value will be ignored.

13.3.14. Compression Ratio Page

BYTE	BIT 7	6	5	4	3	2	1	0
00	RESERVED			Page Code = 39h				
01	RESERVED							
02 03	Page Length = 002Ah							
04 | 09	Write Compression Ratio							
10 | 15	Read Decompression Ratio							
16 | 21	Write Compression Interval 1							
22 | 27	Write Compression Interval 2							
28 | 33	Write Compression Interval 3							
34 | 39	Write Compression Interval 4							
40 | 45	Write Compression Interval 5							

Table 13-58: Compression Ratio Page

Page Code The Page Code for this page is 39h.

Page Length This field is set to 002Ah indicating that the page parameters occupy 42 bytes.

Write Compression Ratio Log Parameter

BYTE	BIT 7	6	5	4	3	2	1	0
n+0 n+1	Parameter Code = 0001h							
n+2	DU	DS	TSD	ETC	TMC		LBIN	LP
n+3	Parameter Length = 02h							
n+4 n+5	Write Compression Ratio							

Table 13-59 Write Compression Ratio Log Parameter

Parameter Code The Parameter Code is set to 0001h.

DU The Disable Update (DU) bit is not defined for List Parameters (indicated by the LP bit) and is set to 0.

(Note: This bit can not be changed by the initiator

DS The Disable Save (DS) bit is set to 1 to indicate that the Drive **does not support saving** of this log parameter.

(Note: This bit can not be changed by the initiator)

TSD The Target Save Disable (TSD) bit is set to 1 to indicate that the Drive does not provide any Drive-defined method for saving of this log parameter.

(Note: This bit can not be changed by the initiator)

ETC The Enable Threshold Comparison (ETC) bit is not defined for List Parameters (indicated by the LP bit) and is set to 0.

(Note: This bit can not be changed by the initiator)

TMC The Threshold Met Criteria (TMC) field is not defined for List Parameters (indicated by the LP bit) and is set to 0.

(Note: This bit can not be changed by the initiator)

LBIN The LBIN bit is set to 1 to indicate that the List Parameter is a binary information.

(Note: This bit can not be changed by the initiator)

LP The List Parameters (LP) bit is set to 1 to indicate that the parameter is a List Parameter.

(Note: This bit can not be changed by the initiator)

Parameter Length This field is set to 02h to indicate that the counter is 2 bytes wide.

Write compression ratio. The compression ratio is reported as the actual compression ratio times 100. The value is reset when a new cartridge is inserted or when starting to write from BOP.

Read Decompression Ratio Log Parameter

BYTE	BIT 7	6	5	4	3	2	1	0
n+0 n+1	Parameter Code = 0002h							
n+2	DU	DS	TSD	ETC	TMC		LBIN	LP
n+3	Parameter Length = 02h							
n+4 n+5	Read Decompression Ratio							

Table 13-60: Read Decompression Log Parameter

Parameter Code The Parameter Code is set to 0002h.

DU The Disable Update (DU) bit is not defined for List Parameters (indicated by the LP bit) and is set to 0.

(Note: This bit can not be changed by the initiator

DS The Disable Save (DS) bit is set to 1 to indicate that the Drive **does not support saving** of this log parameter.

(Note: This bit can not be changed by the initiator)

TSD The Target Save Disable (TSD) bit is set to 1 to indicate that the Drive does not provide any Drive-defined method for saving of this log parameter.

(Note: This bit can not be changed by the initiator)

ETC The Enable Threshold Comparison (ETC) bit is not defined for List Parameters (indicated by the LP bit) and is set to 0.

(Note: This bit can not be changed by the initiator)

TMC The Threshold Met Criteria (TMC) field is not defined for List Parameters (indicated by the LP bit) and is set to 0.

(Note: This bit can not be changed by the initiator)

LBIN The LBIN bit is set to 1 to indicate that the List Parameter is a binary information.

(Note: This bit can not be changed by the initiator)

LP The List Parameters (LP) bit is set to 1 to indicate that the parameter is a List Parameter.

(Note: This bit can not be changed by the initiator)

Parameter Length This field is set to 02h to indicate that the counter is 2 bytes wide.

Read Decompression Ratio The decompression ratio is reported as the actual decompression ratio times 100. The value is reset when a new cartridge is inserted or when starting to write from BOP.

Write Compression Interval 1 Log Parameters

BYTE	BIT 7	6	5	4	3	2	1	0
n+0 n+1	Parameter Code = 0003h							
n+2	DU	DS	TSD	ETC	TMC		LBIN	LP
n+3	Parameter Length = 02h							
n+4 n+5	Write compression interval 1							

Table 13-61: Write Compression Interval 1 Log Parameter

Parameter Code The Parameter Code is set to 0003h.

DU The Disable Update (DU) bit is not defined for List Parameters (indicated by the LP bit) and is set to 0.

(Note: This bit can not be changed by the initiator

DS The Disable Save (DS) bit is set to 1 to indicate that the Drive **does not support saving** of this log parameter.

(Note: This bit can not be changed by the initiator)

TSD The Target Save Disable (TSD) bit is set to 1 to indicate that the Drive does not provide any Drive-defined method for saving of this log parameter.

(Note: This bit can not be changed by the initiator)

ETC The Enable Threshold Comparison (ETC) bit is not defined for List Parameters (indicated by the LP bit) and is set to 0.

(Note: This bit can not be changed by the initiator)

TMC The Threshold Met Criteria (TMC) field is not defined for List Parameters (indicated by the LP bit) and is set to 0.

(Note: This bit can not be changed by the initiator)

LBIN The LBIN bit is set to 1 to indicate that the List Parameter is a binary number.

(Note: This bit can not be changed by the initiator)

LP The List Parameters (LP) bit is set to 1 to indicate that the parameter is a List Parameter.

(Note: This bit can not be changed by the initiator)

Parameter Length This field is set to 02h to indicate that the counter is 2 bytes wide.

Write compression interval 1 This field specifies the amount of data (unit: %) that has a compression ratio between 0.89 and 1.2. The value is reset when a new cartridge is inserted or when starting to write from BOP.

Write Compression Interval 2 Log Parameters

BYTE	BIT 7	6	5	4	3	2	1	0
n+0 n+1	Parameter Code = 0004h							
n+2	DU	DS	TSD	ETC	TMC		LBIN	LP
n+3	Parameter Length = 02h							
n+4 n+5	Write compression interval 2							

Table 13-62: Write Compression Interval 2 Log Parameter

Parameter Code The Parameter Code is set to 0004h.

DU The Disable Update (DU) bit is not defined for List Parameters (indicated by the LP bit) and is set to 0.

(Note: This bit can not be changed by the initiator

DS The Disable Save (DS) bit is set to 1 to indicate that the Drive **does not support saving** of this log parameter.

(Note: This bit can not be changed by the initiator)

TSD The Target Save Disable (TSD) bit is set to 1 to indicate that the Drive does not provide any Drive-defined method for saving of this log parameter.

(Note: This bit can not be changed by the initiator)

ETC The Enable Threshold Comparison (ETC) bit is not defined for List Parameters (indicated by the LP bit) and is set to 0.

(Note: This bit can not be changed by the initiator)

TMC The Threshold Met Criteria (TMC) field is not defined for List Parameters (indicated by the LP bit) and is set to 0.

(Note: This bit can not be changed by the initiator)

LBIN The LBIN bit is set to 1 to indicate that the List Parameter is a binary information.

(Note: This bit can not be changed by the initiator)

LP The List Parameters (LP) bit is set to 1 to indicate that the parameter is a List Parameter.

(Note: This bit can not be changed by the initiator)

Parameter Length This field is set to 02h to indicate that the counter is 2 bytes wide.

Write compression interval 2 This field specifies the amount of data (unit: %) that has a compression ratio between 1.2 and 1.6. The value is reset when a new cartridge is inserted or when starting to write from BOP.

Write Compression Interval 3 Log Parameters

BYTE	BIT 7	6	5	4	3	2	1	0
n+0 n+1	Parameter Code = 0005h							
n+2	DU	DS	TSD	ETC	TMC		LBIN	LP
n+3	Parameter Length = 02h							
n+4 n+5	Write compression interval 3							

Table 13-63: Write Compression Interval 3 Log Parameter

Parameter Code The Parameter Code is set to 0005h.

DU The Disable Update (DU) bit is not defined for List Parameters (indicated by the LP bit) and is set to 0.

(Note: This bit can not be changed by the initiator

DS The Disable Save (DS) bit is set to 1 to indicate that the Drive **does not support saving** of this log parameter.

(Note: This bit can not be changed by the initiator)

TSD The Target Save Disable (TSD) bit is set to 1 to indicate that the Drive does not provide any Drive-defined method for saving of this log parameter.

(Note: This bit can not be changed by the initiator)

ETC The Enable Threshold Comparison (ETC) bit is not defined for List Parameters (indicated by the LP bit) and is set to 0.

(Note: This bit can not be changed by the initiator)

TMC The Threshold Met Criteria (TMC) field is not defined for List Parameters (indicated by the LP bit) and is set to 0.

(Note: This bit can not be changed by the initiator)

LBIN The LBIN bit is set to 1 to indicate that the List Parameter is a binary information.

(Note: This bit can not be changed by the initiator)

LP The List Parameters (LP) bit is set to 1 to indicate that the parameter is a List Parameter.

(Note: This bit can not be changed by the initiator)

Parameter Length This field is set to 02h to indicate that the counter is 2 bytes wide.

Write compression interval 3 This field specifies the amount of data (unit: %) that has a compression ratio between 1.6 – 2.2. The value is reset when a new cartridge is inserted or when starting to write from BOP.

Write Compression Interval 4 Log Parameters

BYTE	BIT 7	6	5	4	3	2	1	0
n+0 n+1	Parameter Code = 0006h							
n+2	DU	DS	TSD	ETC	TMC		LBIN	LP
n+3	Parameter Length = 02h							
n+4 n+5	Write compression interval 4							

Table 13-64: Write Compression Interval 4 Log Parameter

Parameter Code The Parameter Code is set to 0006h.

DU The Disable Update (DU) bit is not defined for List Parameters (indicated by the LP bit) and is set to 0.

(Note: This bit can not be changed by the initiator

DS The Disable Save (DS) bit is set to 1 to indicate that the Drive **does not support saving** of this log parameter.

(Note: This bit can not be changed by the initiator)

TSD The Target Save Disable (TSD) bit is set to 1 to indicate that the Drive does not provide any Drive-defined method for saving of this log parameter.

(Note: This bit can not be changed by the initiator)

ETC The Enable Threshold Comparison (ETC) bit is not defined for List Parameters (indicated by the LP bit) and is set to 0.

(Note: This bit can not be changed by the initiator)

TMC The Threshold Met Criteria (TMC) field is not defined for List Parameters (indicated by the LP bit) and is set to 0.

(Note: This bit can not be changed by the initiator)

LBIN The LBIN bit is set to 1 to indicate that the List Parameter is a binary information.

(Note: This bit can not be changed by the initiator)

LP The List Parameters (LP) bit is set to 1 to indicate that the parameter is a List Parameter.

(Note: This bit can not be changed by the initiator)

Parameter Length This field is set to 02h to indicate that the counter is 2 bytes wide.

Write compression interval 4 This field specifies the amount of data (unit: %) that has a compression ratio between 2.2 and 3.6. The value is reset when a new cartridge is inserted or when starting to write from BOP.

Write Compression Interval 5 Log Parameters

BYTE	BIT 7	6	5	4	3	2	1	0
n+0 n+1	Parameter Code = 0007h							
n+2	DU	DS	TSD	ETC	TMC		LBIN	LP
n+3	Parameter Length = 02h							
n+4 n+5	Write compression interval 5							

Table 13-65: Write Compression Interval 5 Log Parameter

Parameter Code The Parameter Code is set to 0007h.

DU The Disable Update (DU) bit is not defined for List Parameters (indicated by the LP bit) and is set to 0.

(Note: This bit can not be changed by the initiator

DS The Disable Save (DS) bit is set to 1 to indicate that the Drive **does not support saving** of this log parameter.

(Note: This bit can not be changed by the initiator)

TSD The Target Save Disable (TSD) bit is set to 1 to indicate that the Drive does not provide any Drive-defined method for saving of this log parameter.

(Note: This bit can not be changed by the initiator)

ETC The Enable Threshold Comparison (ETC) bit is not defined for List Parameters (indicated by the LP bit) and is set to 0.

(Note: This bit can not be changed by the initiator)

TMC The Threshold Met Criteria (TMC) field is not defined for List Parameters (indicated by the LP bit) and is set to 0.

(Note: This bit can not be changed by the initiator)

LBIN The LBIN bit is set to 1 to indicate that the List Parameter is a binary information.

(Note: This bit can not be changed by the initiator)

LP The List Parameters (LP) bit is set to 1 to indicate that the parameter is a List Parameter.

(Note: This bit can not be changed by the initiator)

Parameter Length This field is set to 02h to indicate that the counter is 2 bytes wide.

Write compression interval 5 This field specifies the amount of data (unit: %) that has a compression ratio greater than 3.6. The value is reset when a new cartridge is inserted or when starting to write from BOP.

13.4. Exception Handling

See section on *Error Conditions For All Commands*.

If the PPC or Parameter Pointers field is different from zero, the Drive will return CHECK CONDITION status. No parameter data is sent. The Error Code is set to INVALID FIELD IN CDB.

If the Page Code field is not in the range of legal values, the Drive will return CHECK CONDITION status. No parameter data is sent. The Error Code is set to INVALID FIELD IN CDB.

13.5. Phase Sequencing

In this section the possible SCSI-bus phase sequences during execution of the command are described. Section 3.2.1 has more details about the generic phases in the brackets.

<sequence 1> := <initiator-part> <message-out> <command> <disconnect> <reconnect> <data-in> <completed>

When disconnection is allowed the Drive will disconnect when the CDB has been transferred. The Drive will reconnect when the parameters are ready for transfer.

<sequence 2> := <initiator-part> <message-out> <command> <data-in> <completed>

This sequence is used when disconnection is not allowed.

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14. Mode Select

14.1. Command Description

The MODE SELECT command provides a means for the Initiator to specify a number of device parameters in the Drive. New parameter values are included in the MODE SELECT Parameter List.

The Drive implements only one common set of parameters for all Initiators. If any parameters that affect another Initiator are changed, the Drive will generate a Unit Attention condition (with a MODE PARAMETERS CHANGED Error Code) for all Initiators except the one that issued the MODE SELECT command.

The MODE SELECT Parameter List will be transferred during the DATA-OUT phase of the command.

The Tandberg SLR Product Line Tape Drives support *parameter saving*. Parameters marked as savable may be saved to a non-volatile storage by setting the Save Pages (SP) bit in the CDB. Saved parameter values will be used as current values after next power-up or reset.

If disconnection is allowed, the Drive will disconnect when executing this command.

14.2. Command Descriptor Block

BYTE	BIT 7	6	5	4	3	2	1	0
00	Operation Code **15h**							
01	Logical Unit Number (LUN)			PF	RESERVED			SP
02	RESERVED							
03	RESERVED							
04	Parameter List Length							
05	Control Byte							

Table 14-1: MODE SELECT Command Descriptor Block

PF

A Page Format (PF) bit of zero indicates that the Drive will not accept any Mode Pages in the parameter list; only the Header List and a Block Descriptor List will be accepted. If the Drive receives a parameter list containing bytes beyond the Header List and a Block Descriptor List, it will terminate the MODE SELECT command with CHECK CONDITION. A PF bit of one indicates that the Drive will accept the Mode Pages as defined in this specification.

SP

A Save Pages (SP) bit of zero indicates that the Drive will perform the specified MODE SELECT operation, but not save any mode parameters. A SP bit of one indicates that the Drive will perform the specified MODE SELECT operation and save all savable MODE SELECT parameters including any sent during the DATA-OUT phase [1].

Parameter List Length

This field specifies the length in bytes of the MODE SELECT parameter list that will be transferred from the Initiator to the Drive during the DATA-OUT phase. A Parameter List Length of zero indicates that no data will be transferred. No mode selection parameters are then changed. If the parameter list length results in truncation of any Header, Descriptor or Page, the Mode Select command terminate with CHECK CONDITION.

14.3. Parameter List

The MODE SELECT parameter list consists of three sub-lists. The first list is a 4 byte Header List. This may be followed by a 8 byte Block Descriptor List. At last there may be one or more Page Descriptor Lists. The Page Descriptor Lists may be transferred in any order.

The Drive supports the following Page Descriptor Lists:

01h :	Read-Write Error Recovery Page	🖫
02h :	Disconnect/Reconnect Page	🖫
0Ah :	Control Mode Page	
0Fh :	Data Compression Page	🖫
10h :	Device Configuration Page	🖫
11h :	Medium Partition Page(1)	
1Ch:	Informational Exceptions Control Page	
20h :	Miscellaneous Parameter Page	🖫
21h :	User Page 0	🖫
22h :	User Page 1	🖫
23h :	Cartridge Manufacturer Page	

🖫 : This page is savable

[1] The Drive is specified to perform up to a maximum of 100 000 save operations.

14.3.1. Header List

BYTE	BIT 7	6	5	4	3	2	1	0
00	RESERVED							
01	RESERVED							
02	R	Buffered Mode			Tape Speed			
03	Block Descriptor Length							

Table 14-2: MODE SELECT Header List

Buffered Mode

The Drive supports the following mode: 0 and 1. Mode 0 indicates that the WRITE and WRITE FILEMARKS) command will report GOOD status when the requested data blocks have been actually written and verified. Mode 1 indicates that the WRITE and WRITE FILEMARKS commands will report GOOD status as soon as the requested data has been transferred into the Drive's data buffer.

⇨ Legal values are 0 and 1.

⇨ The default (factory programmed) value is 1.

Tape Speed

This field specifies the current tape speed. The following values are legal:

0h : Default
1h : Low Speed
2h : Medium Speed
3h : High Speed

The following tables show the actual tape speed (ips[1]) and the resulting data transfer rate (MBytes/s) for the different drives and tape formats.

SLR140 Drive:

Medium Type	Default Speed		Low Speed		Medium Speed		High Speed	
SLRtape140	86 ips	6 MB/s	72 ips	5 MB/s	72 ips	5 MB/s	86 ips	6 MB/s
SLRtape100	88 ips	5 MB/s	88 ips	5 MB/s	88 ips	5 MB/s	88 ips	5 MB/s
SLRtape75	88 ips	5 MB/s	88 ips	5 MB/s	88 ips	5 MB/s	88 ips	5 MB/s
SLRtape60	88 ips	5 MB/s	88 ips	5 MB/s	88 ips	5 MB/s	88 ips	5 MB/s
SLRtape50	103 ips	2 MB/s	103 ips	2 MB/s	103 ips	2 MB/s	103 ips	2 MB/s
SLRtape40	88 ips	5 MB/s	88 ips	5 MB/s	88 ips	5 MB/s	88 ips	5 MB/s
SLRtape7	88 ips	2.5 MB/s	88 ips	2.5 MB/s	88 ips	2.5 MB/s	88 ips	2.5 MB/s

Table 14-3: Available Tape Speeds for SLR140

[1] *ips is inches per second,* 1 inch = 25.4 mm

SLR100 Drive:

Medium Type	Default Speed		Low Speed		Medium Speed		High Speed	
SLRtape100	88 ips	5 MB/s	53 ips	3 MB/s	70 ips	4 MB/s	88 ips	5 MB/s
SLRtape75	88 ips	5 MB/s	53 ips	3 MB/s	70 ips	4 MB/s	88 ips	5 MB/s
SLRtape60	88 ips	5 MB/s	53 ips	3 MB/s	70 ips	4 MB/s	88 ips	5 MB/s
SLRtape50	103 ips	2 MB/s	103 ips	2 MB/s	103 ips	2 MB/s	103 ips	2 MB/s
SLRtape40	88 ips	5 MB/s	53 ips	3 MB/s	70 ips	4 MB/s	88 ips	5 MB/s
SLRtape7	88 ips	2.5 MB/s	88 ips	2.5 MB/s	88 ips	2.5 MB/s	88 ips	2.5 MB/s
SLR32	98 ips	1.2 MB/s	98 ips	1.2 MB/s	98 ips	1.2 MB/s	98 ips	1.2 MB/s
SLRtape24	98 ips	1.2 MB/s	98 ips	1.2 MB/s	98 ips	1.2 MB/s	98 ips	1.2 MB/s

Table 14-4: Available Tape Speeds for SLR100

SLR75 Drive:

Medium Type	Default Speed		Low Speed		Medium Speed		High Speed	
SLRtape75	70 ips	4 MB/s	53 ips	3 MB/s	70 ips	4 MB/s	70 ips	4 MB/s
SLRtape60	70 ips	4 MB/s	53 ips	3 MB/s	70 ips	4 MB/s	70 ips	4 MB/s
SLRtape50	103 ips	2 MB/s	103 ips	2 MB/s	103 ips	2 MB/s	103 ips	2 MB/s
SLRtape40	70 ips	4 MB/s	53 ips	3 MB/s	70 ips	4 MB/s	70 ips	4 MB/s
SLRtape7	70 ips	2 MB/s	70 ips	2 MB/s	70 ips	2 MB/s	70 ips	2 MB/s
SLR32	98 ips	1.2 MB/s	98 ips	1.2 MB/s	98 ips	1.2 MB/s	98 ips	1.2 MB/s
SLRtape24	98 ips	1.2 MB/s	98 ips	1.2 MB/s	98 ips	1.2 MB/s	98 ips	1.2 MB/s
SLR5	98 ips	0.48 MB/s	98 ips	0.48 MB/s	98 ips	0.48 MB/s	98 ips	0.48 MB/s
DC9250	98 ips	0.39 MB/s	98 ips	0.39 MB/s	98 ips	0.39 MB/s	98 ips	0.39 MB/s

Table 14-5: Available Tape Speeds for SLR75

SLR60 Drive:

Medium Type	Default Speed		Low Speed		Medium Speed		High Speed	
SLRtape75	70 ips	4 MB/s	53 ips	3 MB/s	70 ips	4 MB/s	70 ips	4 MB/s
SLRtape60	70 ips	4 MB/s	53 ips	3 MB/s	70 ips	4 MB/s	70 ips	4 MB/s
SLRtape50	103 ips	2 MB/s	103 ips	2 MB/s	103 ips	2 MB/s	103 ips	2 MB/s
SLRtape40	70 ips	4 MB/s	53 ips	3 MB/s	70 ips	4 MB/s	70 ips	4 MB/s
SLRtape7	70 ips	2 MB/s	70 ips	2 MB/s	70 ips	2 MB/s	70 ips	2 MB/s
SLR32	98 ips	1.2 MB/s	98 ips	1.2 MB/s	98 ips	1.2 MB/s	98 ips	1.2 MB/s
SLRtape24	98 ips	1.2 MB/s	98 ips	1.2 MB/s	98 ips	1.2 MB/s	98 ips	1.2 MB/s
SLR5	98 ips	0.48 MB/s	98 ips	0.48 MB/s	98 ips	0.48 MB/s	98 ips	0.48 MB/s
DC9250	98 ips	0.39 MB/s	98 ips	0.39 MB/s	98 ips	0.39 MB/s	98 ips	0.39 MB/s

Table 14-6: Available Tape Speeds for SLR60

SLR50 Drive:

Medium Type	Default Speed		Low Speed		Medium Speed		High Speed	
SLRtape50	103 ips	2 MB/s	52 ips	1 MB/s	52 ips	1 MB/s	103 ips	2 MB/s
SLR32	120 ips	1.5 MB/s	60 ips	0.75 KB/s	60 ips	0.75 MB/s	120 ips	1.5 MB/s
SLRtape24	120 ips	1.2 MB/s	60 ips	0.6 MB/s	60 ips	0.6 MB/s	120 ips	1.2 MB/s
SLR5	118 ips	0.58 MB/s	118 ips	0.58 MB/s	118 ips	0.58 MB/s	118 ips	0.58 MB/s
DC9250	120 ips	0.48 MB/s	120 ips	0.48 MB/s	120 ips	0.48 MB/s	120 ips	0.48 MB/s

Table 14-7: Available Tape Speeds for SLR50.

SLR7 Drive:

Medium Type	Default Speed		Low Speed		Medium Speed		High Speed	
SLRtape7	105 ips	3 MB/s	105 ips	3 MB/s	105 ips	3 MB/s	105 ips	3 MB/s
SLR5	98 ips	0.48 MB/s	98 ips	0.48 MB/s	98 ips	0.48 MB/s	98 ips	0.48 MB/s

Table 14-8: Available Tape Speeds for SLR7

⇨ Legal values are numbers in the range 0..3.

⇨ The default (factory programmed) value is 0.

Note that the AVC bit (Auto Velocity Control, see *14.3.7. Device Configuration Page*) has priority over the Tape Speed field. This means that when AVC is active the drive ignores the value of the Tape Speed field.

Block Descriptor Length

This field specifies the length in bytes of the block descriptor list. Legal values are either 0 or 8. A value of zero means that no block descriptor list is included in the Parameter List.

14.3.2. Block Descriptor List

BYTE	BIT 7	6	5	4	3	2	1	0
00	Density Code							
01 02 03	Number of Blocks							
04	RESERVED							
05 06 07	Block Length							

Table 14-9: MODE SELECT Block Descriptor List

Density Code This field indicates the tape format to use when a write operation is started. Possible values are:

Density Code	Tape Format Selected	Suitable Medium
00h	*Default Density* (see below)	*Current medium* (see below)
21h	QIC-5010-DC	SLR32
22h	QIC-2GB-DC	DC9250
26h	QIC-4GB-DC	SLR5
30h	MLR3	SLRtape50
32h	ALRF-2	SLRtape7
33h	SLR6	SLRtape24
34h	ALRF-1	SLRtape40, SLRtape60, SLRtape75, SLRtape100, SLR40/60/100 - 10GB
36h	ALRF-6	SLRtape140
7Fh	*No change* (see below)	-

Table 14-10: Density codes, formats and suitable medium

⇨ The factory programmed value is 00h (Default Density)

Note that the different drive types will not be compatible with all medium types. See table 1-1 for an overview. See also Table 30-2 for more specific details.

The Density Code field should be set 7Fh (No change) unless a specific density is desired (this is especially useful when a combination of a MODE SENSE and a MODE SELECT command is used to manipulate mode parameter values as a MODE SENSE command returns the current density code).

When a Default Density code has been selected (00h), the Drive will always try to use the tape format giving the largest capacity on a given cartridge. The chosen density code is reported back to the Density Code field of the Block Descriptor List of the MODE SENSE command after any read or write operation. When writing from BOP Table 14-8 shows the selected density (tape format) for the various types of media (cartridge types).

A MODE SELECT command changing the density code may be executed at any time. Note, however, that a change of density code will only take effect when a possible next

write operation (executed by a WRITE or WRITE FILEMARKS command) is started from Beginning of Media, BOM (i.e. BOP on partition 0)[1]. This means that changing the density code when the tape is positioned off BOM will not take effect on a next write operation off BOM.

When appending data on a pre-recorded tape, the current density code will be ignored, and the drive will always use the same density as on the tape.

When a default density code has been selected, the Drive will always try to use the tape format giving the largest capacity on a given cartridge. The chosen density code is reported back to the Density Code field of the Block Descriptor List of the MODE SENSE command after any read or write operation. When writing from BOP the following table shows the selected density (tape format) for the various types of media (cartridge types):

[1] The tape must be brought to BOM either by inserting a new cartridge or by a move type command according to the command and modes specified in Section 4.4. If the tape is brought to BOM by a read or navigate type command (SPACE/LOCATE), the selected density will not take effect

Medium	Tape Format Selected (Default Density Code)
DC300 DC300XLP DC615 DC600A DC6037 DC6150 DC6250 DC6320 DC6525 DC9100 DC9100FW DC9120 DC9120SL DC9120XL	These mediums require an unsupported tape format. The Drive issues an INCOMPATIBLE MEDIUM INSTALLED error message when an attempt is made to read or write on these cartridges.
DC9200 DC9200SL DC9250	The Drive selects the QIC-2GB-DC tape format (density code = 22h)
SLR5 SLR5SL	The Drive selects the QIC-4GB-DC tape format (density code = 26h)
SLRtape24 SLRtape24SL	The Drive selects the SLR6 tape format (density code = 33h)
MLR1-26GB MLR1-26GBSL SLR32 SLR32SL	The Drive selects the QIC-5010-DC tape format (density code = 21h)
SLRtape50 SLRtape50SL	The Drive selects the MLR3 tape format (density code = 30h)
SLRtape7 SLRtape7 SL	The Drive selects the ALRF-2 tape format (density code = 32h)
SLR40/60/100 - 10GB SLRtape40 SLRtape60 SLRtape75 SLRtape100	The Drive selects the ALRF-1 tape format (density code = 34h)
SLRtape140	The Drive selects the ALRF-6 tape format (density code = 36h)

Table 14-11: Type of Media Related to Tape Format

NOTES:
Use of older cartridge types in SLR140, SLR100, SLR75, SLR60 and SLR7 drives:

The SLR140, SLR100, SLR75, SLR60 and SLR7 tape drives are designed to achieve the highest quality and performance using advanced tape technology. The head used in these drives contains sensitive MR elements tailored to the high bit densities stored on the SLRtape140, SLRtape100, SLRtape75, SLRtape60, SLRtape40 SLRtape7 media, and the other media compatible with the SLR140, SLR100, SLR75, SLR60 and SLR7 drives. The 1650 Oe and 900 Oe media (SLRtape140 down to DC9250 medium types) are designed to be used with the advanced MR head designs.

Old cartridge types using 550 Oe media (DC600A, DC6150, DC6250, DC6320, DC6525) are harmful for MR heads since these media types do contain large abrasive particles designed to clean older metal and ferrite heads. Loading such cartridges into an SLR140, SLR100, SLR75, SLR60 and SLR7 drive, may damage the advanced head used in these drives and could cause a drive failure to occur. These cartridge types are illegal on the SLR140, SLR100, SLR75, SLR60 and SLR7 drives.

Care should be taken to avoid any accidental load of 550 Oe media in the SLR140, SLR100, SLR75, SLR60 and SLR7 drives.

Note that the different drive types will not have write compatibility on all tape formats. See table 1-1 for an overview. See also Table 30-2 for details on which medium types that can be used for which tape format.

Note also that not all combinations of tape formats and block lengths are allowed (see the description of the *Block Length* field).

Number Of Blocks

This field must be set to zero, it is not changeable (the whole tape must have the same density code).

Block Length

This field selects the Block Length used (on the SCSI-bus) when reading, verifying and writing fixed length blocks.

Block Length	Description
000000h	The Drive is set into Variable Block mode. In this mode it is illegal to issue commands that have the FIX bit set to one. Only variable block READ, VERIFY[1] or WRITE commands are allowed. When writing variable blocks the Drive will write all blocks as Variable Data Blocks according to the corresponding QIC Development Standards [9] - [13]. See also the section on the READ command for further details on the difference between Variable Block mode and Fixed Block mode.
000002h – 40000h	When the value in the Block Length field is different from 000000h, the Drive is set into Fixed Block Mode. The Block Length used when transferring fixed length blocks on the SCSI-bus is given by the specified value. When using an SLRtape140, SLRtape100, SLRtape75, SLRtape60, SLRtape50, SLRtape40, SLRtape7, SLR32 or SLRtape24 medium the block length can be set to any *even* value in the range 2 to 262144 (40000h). When using an SLR5 or DC9250 medium, the only legal Fixed Block Mode block lengths are 512 (200h) and 1024 (400h) bytes. When writing 512 byte fixed length blocks on an SLR5 or DC9250 medium, the Drive will pack two 512 byte logical blocks into one physical tape block according to [9], [10]. When the block length is different from 512 and 1024 bytes, the Drive will write all logical blocks as Variable Length Data blocks as defined in [9], [10].

Table 14-12: Fixed Block Lengths

The length of fixed length logical blocks is set by the three bytes available in the Block Length field. The table below indicates the legal block length values for the different tape formats.

[1] VERIFY is not supported by SLR7 and SLR140

Medium Type	Fixed Block Length[1]	Variable Block Length
SLRtape140	2 .. 262144	1 .. 262144
SLRtape100	2 .. 262144	1 .. 262144
SLRtape75	2 .. 262144	1 .. 262144
SLRtape60	2 .. 262144	1 .. 262144
SLRtape50	2 .. 262144	1 .. 262144
SLRtape40	2 .. 262144	1 .. 262144
SLRtape7	2 .. 262144	1 .. 262144
SLR32	2 .. 262144	1 .. 262144
SLRtape24	2 .. 262144	1 .. 262144
SLR5	512 and 1024	1 .. 262144
DC9250	512 and 1024	1 .. 262144

Table 14-13: Legal Block Lengths (bytes)

When the current tape format is not known (like when there is no medium inserted), the MODE SELECT command will allow any *even* block length in the range 2..262144. However, when the tape format becomes known and a WRITE command is issued, the drive will verify that the configured current configured block length is legal. If the block length is outside the range of legal values the WRITE command will be terminated immediately with CHECK CONDITION status. If the block length specified is odd the MODE SELECT command will be terminated with CHECK CONDITION status immediately.

[1] Only *even* blocks lengths are allowed

14.3.3. Read-Write Error Recovery Page

This page is used to specify error recovery and reporting parameters.

The page can be saved.

BYTE	BIT 7	6	5	4	3	2	1	0
00	PS	R	Page Code = 01h					
01	Page Length = 0Ah							
02	RESERVED		TB	R	EER	PER	DTE	DCR
03	Read Retry Count							
04	RESERVED							
05	RESERVED							
06	RESERVED							
07	RESERVED							
08	Write Retry Count							
09	RESERVED							
10	RESERVED							
11	RESERVED							

Table 14-14: Read-Write Error Recovery Page Descriptor

PS The Parameter Savable (PS) bit must be set to zero.

Page Code The Page Code for this page must be set to 01h.

Page Length The Page Length field must always be set to 0Ah.

TB The Transfer Block (TB) bit must be set to 0, it is not changeable (an unrecoverable data block will not be transferred to the initiator when an unrecoverable read error has occurred).

EER The enable early recovery (EER) bit must be set to 1, it is not changeable (the Drive will always enable the use of ECC *before* applying retries).

PER The Post Error Recovery (PER) bit must be set to 0, it is not changeable (the Drive will not return CHECK CONDITION status for recovered errors).

DTE The disable transfer on error (DTE) bit must be set to 0, it is not changeable (the Drive will not terminate the data transfer for recovered errors).

DCR

A Disable Correction (DCR) bit of one indicates that the Drive will disable the ECC mechanism. Even if a block is correctable, the Drive will not correct it, but instead use rereads only to recover the block. A DCR bit of zero indicates that the Drive will use ECC correction whenever possible. This bit should always be set to zero (it is intended for Tandberg Data internal use only).

Read Retry Count

The read retry count specifies the number of times that the Drive should attempt to re-read a block. This field is changeable.

> NOTE:
> SLR7/60/100/140 will override this setting and use maximum number of re-reads.

⇨ Legal values are numbers in the range 1..24

⇨ The default (factory programmed) value is 24.

Write Retry Count

The write retry count specifies the number of times the Drive should attempt to re-write a block. This field is changeable.

⇨ Legal values are numbers in the range 1..16

⇨ The default (factory programmed) value is 16.

14.3.4. Disconnect/Reconnect Page

This page is used to specify the Drive's disconnect and reconnect parameters.

The page can be saved.

BYTE	BIT 7	6	5	4	3	2	1	0
00	PS	R	Page Code = 02h					
01	Page Length = 0Eh							
02	Read Buffer Full Ratio							
03	Write Buffer Empty Ratio							
04 05	Bus Inactivity Time							
06 07	Disconnect Time Limit							
08 09	Connect Time Limit							
10 11	Maximum Burst Size							
12	EMDP	FARd	FAWrt	FAStat	DImm	DTDC		
13	RESERVED							
14 15	First Burst Size							

Table 14-15: Disconnect/Reconnect Page Descriptor

PS The Parameter Savable (PS) bit must be set to zero.

Page Code The Page Code for this page must be set to 02h.

Page Length The Page Length field must always be set to 0Eh.

Read Buffer Full Ratio The read buffer full ratio indicates to the Drive, on READ commands, how full the buffer will be prior to reconnecting. The read buffer full ratio is a number in the range 0..255. A value of 0 indicates that only one block ready in the buffer is enough to force a reconnect. A value of 255 indicates that the buffer must be almost 100 % full before a reconnect occurs (assuming a 4 MByte data buffer). This field is changeable.

The actual amount of data (in number of bytes) needed for a reconnect can be calculated using the following formula:

Nb = 512 **for Rbfr equal to 0**
Nb = (Rbfr * 16 KBytes) **for Rbfr *not* equal to 0**

(Where Nb = Number of bytes and Rbfr = Read Buffer Full Ratio)

If the specified Read Buffer Full Ratio corresponds to an amount of data that is larger than the installed data buffer size, the drive will round the Read Buffer Full Ratio down to a value corresponding to the actual buffer size.

⇨ Legal values are numbers in the range 0..255.

⇨ The default (factory programmed) value is 16 (i.e. 256 KBytes).

Write Buffer Empty Ratio

The write buffer empty ratio indicates to the Drive, on VERIFY and WRITE commands, how empty the buffer will be prior to reconnecting to fetch more data. The write buffer empty ratio is a number in the range 0..255. A value of 0 indicates that if there is room for just one block in the buffer then the Drive will reconnect. A value of 255 indicates that the buffer must be almost 100 % empty before a reconnect occurs (assuming a 4 MByte data buffer). This field is changeable.

The actual amount of data (in number of bytes) needed for a reconnect can be calculated using the following formula:

Nb = 512	**for Wber equal to 0**
Nb = (Wber * 16 KBytes)	**for Wber *not* equal to 0**

(Where Nb = Number of bytes and Wber = Write Buffer Empty Ratio)

If the specified Write Buffer Empty Ratio corresponds to an amount of data that is larger than the installed data buffer size, the drive will round the Read Buffer Full Ratio down to a value corresponding to the actual buffer size.

⇨ Legal values are numbers in the range 0..255.

⇨ The default (factory programmed) value is 16 (i.e. 256 KBytes).

Bus Inactivity Time Limit

This field must be set to 0, it is not changeable (there is no limit for how long the Drive is permitted to assert the BSY signal without a REQ/ACK handshake).

Disconnect Time Limit

This field must be set to 0, it is not changeable (there is no disconnect time limit).

Connect Time Limit

This field must be set to 0, it is not changeable (there is no limit for how long the Drive is allowed to use the SCSI-bus before it disconnects).

Maximum Burst Size

This field indicates the maximum amount of data in 512 byte increments that the Drive can transfer on the SCSI-bus before disconnecting. A value of zero indicates that there is no limit.

⇨ Legal values are numbers in the range 0..65536.

⇨ The default (factory programmed) value is 0.

EMDP

The Enable Modify Data Pointer (EMDP) bit must be set to 0, it is not changeable (the Drive does not support re-ordering of data transfers).

FARd

The Fair Arbitration Read (FARd) bit must be set to 0, it is not changeable (the Drive only supports priority arbitration).

FAWrt

The Fair Arbitration Write (FAWrt) bit must be set to 0, it is not changeable (the Drive only supports priority arbitration).

FASTat

The Fair Arbitration Status (FAStat) bit must be set to 0, it is not changeable (the Drive only supports priority arbitration).

DImm The Disconnect Immediate (DImm) bit must be set to 0, it is not changeable (the Drive may transfer data for a command during the same interconnect tenancy in which it receives the command).

DTDC The Data Transfer Disconnect Control field must be set to 00h, this field is not changeable (data transfer disconnect control is not used).

First Burst Size The First Burst Size field must be set to zero, it is not changeable (there is no first burst size limit).

14.3.5. Control Mode Page

This page is used to specify features as tagged queuing, asynchronous event reporting and error logging.

The page can not be saved.

BYTE	BIT 7	6	5	4	3	2	1	0
00	PS	R	Page Code = 0Ah					
01	Page Length = 0Ah							
02	RESERVED						GLTSD	RLEC
03	Queue Algorithm Modifier				RESERVED		QErr	DQue
04	R	RAC	RESERVED		SWP	RAERP	UAAERP	EAERP
05	RESERVED							
06 07	Ready AER Holdoff period							
08 09	Busy Timeout Period							
10	RESERVED							
11	RESERVED							

Table 14-16: Control Mode Page Descriptor

PS The Parameter Savable (PS) bit must be set to zero.

Page Code The Page Code for this page must be set to 0Ah.

Page Length The Page Length field must always be set to 0Ah.

GLTSD The Global Logging Target Save Disable (GLTSD) bit must be set to 0, it is not changeable (the Drive will provide a target-defined method for saving log parameters).

RLEC A Report Log Exception Condition (RLEC) bit of one indicates that the Drive will report log exception conditions. A RLEC bit of zero indicates that the Drive will not report log exception conditions. See the LOG SELECT command for further information on threshold criteria and enabling of threshold comparison (ET).

⇨ Legal values are 0 and 1.

⇨ The default (factory programmed) value is 0.

Queue Algorithm Modifier The Queue Algorithm Modifier field must be set to 0h, it is not changeable. The Drive does not support tagged queuing.

QErr The Queue Error Management (QErr) field must be set to 0h, it is not changeable. The Drive does not support tagged queuing.

DQue The Disable Queuing (DQue) field must be set to 0h, it is not changeable. The CmdQue bit in the INQUIRY Parameter List indicates that the Drive not supports tagged queuing.

RAC

The Report A Check (RAC) field must be set to 0h, it is not changeable. The Drive will report long busy condition instead of CHECK CONDITION.

SWP

The Software Write Protect (SWP) bit must be set to 0h, it is not changeable. The Drive does not support software write protect.

RAERP

The RAERP field must be set to 0h, it is not changeable. The Drive does not support asynchronous event notification.

UAAERP

The UAAERP field must be set to 0h, it is not changeable. The Drive does not support asynchronous event notification.

EAERP

The EAERP field must be set to 0h, it is not changeable. The Drive does not support asynchronous event notification.

Ready AER Holdoff Period

The Ready AER Holdoff period field must be set to 0h, it is not changeable. The Drive does not support asynchronous event notification.

Queue Algorithm Modifier

This field must be set to 0h, it is not changeable. The drive does not support tagged queuing.

Busy Timeout Period

This field must be set to FFFFh, it is not changeable (the Initiator allows the Drive to remain busy for an unlimited period for unanticipated conditions which are not a routine part of commands from the Initiator).

14.3.6. Data Compression Page

This page is used to specify data compression configurations.

The page can be saved.

BYTE	BIT 7	6	5	4	3	2	1	0
00	PS	R	Page Code = 0Fh					
01	Page Length = 0Eh							
02	DCE	DCC	RESERVED					
03	DDE	RED		RESERVED				
04 | 07	Compression Algorithm							
08 | 11	Decompression Algorithm							
12	RESERVED							
13	RESERVED							
14	RESERVED							
15	RESERVED							

Table 14-17: Data Compression Page Descriptor

PS The Parameter Savable (PS) bit must be set to zero.

Page Code This field is always set to 0Fh.

Page Length This field must be set to 0Eh.

DCE A Data Compression Enable (DCE) bit of one indicates that the data compression is enabled. When this bit is set, data sent to the Drive by the initiator shall be processed using the selected Compression Algorithm before being written to the medium. A DCE bit of zero indicates that the data compression is disabled. The DCE-bit can only be set to one if the DCC-bit indicates that the Drive supports data compression.

⇨ Legal values are 0 and 1.

⇨ The default (factory programmed) value is 1.

DCC A Data Compression Capable (DCC) bit of one indicates that the Drive supports data compression. A DCC bit of zero indicates that the Drive does not support data compression. This bit does only make sense for the Mode Sense command. This bit is not changeable.

DDE

When using SLRtape140 to SLRtape7 or SLR32, media the Data Decompression Enable (DDE) bit is ignored (data decompression is always enabled regardless of the state of the DDE bit).

When using other media the DDE is a status bit and not a configuration bit. This means that the MODE SELECT command will ignore the DDE bit (data decompression is always enabled). For the MODE SENSE command the DDE bit is a status bit that indicates if the medium is being written with compressed data (write mode) or if pre-written compressed data is being read (read mode). The DDE bit has a valid state after a READ, VERIFY[1] and WRITE command.

See section *2.8 Data Compression* for further details on how to use the DDE bit.

RED

The Report Exception on Decompression (RED) field indicates how the Drive responds on certain boundaries between compressed and uncompressed data read from the tape. This field is ignored and can be set to any value. The Drive will report CHECK CONDITION status when compressed data is encountered which the Drive cannot decompress (unsupported algorithm).

⇨ The default (factory programmed) value is 0.

Compression Algorithm

The Compression Algorithm field indicates the compression algorithm the Drive shall use to process the data sent to it by the Initiator when the DCE bit is set to one.

The following values are legal:

00 00 00 00h : No Algorithm Selected (identifies uncompressed data).
00 00 00 03h : ALDC Data Compression Algorithm.

⇨ The default (factory programmed) value is 00 00 00 03h

Decompression Algorithm

The Decompression Algorithm field is ignored by Mode Select because the Drive is capable of automatic recognition of the Compression Algorithm used to process data encountered on the medium. The Decompression Algorithm value returned in response to a Mode Sense command will change dynamically to reflect the algorithm used by the Drive to decompress the data most recently transferred to the Initiator during a read operation. A value of zero indicates that the data transferred to the Initiator during the most recent read operation was uncompressed.

[1] VERIFY is not supported by SLR7 and SLR140

14.3.7. Device Configuration Page

This page is used to specify various Drive configurations.

The page can be saved.

BYTE	BIT 7	6	5	4	3	2	1	0
00	PS	R	Page Code = 10h					
01	Page Length = 0Eh							
02	R	CAP	CAF	Active Format				
03	Active Partition							
04	Write Buffer Full Ratio							
05	Read Buffer Empty Ratio							
06 07	Write Delay Time							
08	DBR	BIS	RSMK	AVC	SOCF		RBO	REW
09	Gap Size							
10	EOD Defined			EEG	SEW	SWP	RESERVED	
11 12 13	Buffer Size at Early Warning							
14	RESERVED							RFTD
15	RESERVED							

Table 14-18: Device Configuration Page Descriptor

PS The Parameter Savable (PS) bit must be set to zero.

Page Code This field is always set to 10h.

Page Length This field must be set to 0Eh.

CAP A Change Active Partition (CAP) bit of one indicates that the logical partition is to be changed to the one specified in the Active Partition field. A CAP bit of one is only valid when using SLRtape140 to SLRtape7 or SLR32, media. A CAP bit of zero indicates that no partition change is specified. See also section *2.3 Partitions Within a Volume* for further details.

CAF The Change Active Format (CAF) bit must be set to 0, it is not changeable (no active format change can be specified).

Active Format The Active Format field must be set to 0, it is not changeable.

Active Partition This field indicates the current partition number in use on the medium when the CAP bit is set to one. This field is ignored when the CAP bit is zero. The drive will signal a CHECK CONDITION if the addressed partition does not exist. The Active Partition is not savable. The Drive will always be set to Partition 0 after a reset.

After a change of partition the tape will be positioned at BOP. This will be true even if the specified Active Partition equals the current partition.

See also section *2.3 Partitions Within a Volume* for further details.

⇨ Legal values are 0 to 35.

⇨ The default (factory programmed) value is 0.

Write Buffer Full Ratio The Drive only supports a single fixed Write Buffer Full Ratio so this field must be set to zero. This field is not changeable.

Read Buffer Empty Ratio The Drive only supports a single fixed Read Buffer Empty Ratio so this field must be set to zero. This field is not changeable.

Write Delay Time The Write Delay Time field is ignored by the Drive.

DBR The Data Buffer Recover (DBR) bit must be set to 0, it is not changeable (the Drive does not support the RECOVER BUFFERED DATA command).

BIS The Block Identifiers Supported (BIS) bit must be set to 1, it is not changeable (the Drive supports Block Identifiers).

RSMK The Report Setmarks (RSMK) bit must be set to 1, it is not changeable (the Drive reports setmarks).

AVC If the Automatic Velocity Control (AVC) bit is set to one, the Drive will select the speed which, based on the data transfer rate, will optimize streaming activity and minimize medium repositioning (only if more than one speed is available for the active tape format). If the AVC bit is zero, the speed specified in the header list is chosen.

⇨ Legal values are 0 and 1.

⇨ The default (factory programmed) value is 1.

Note that the AVC bit has priority over the Tape Speed field (see section *14.3.1. Header List*). This means that when AVC is active the drive ignores the value of the Tape Speed field.

SOCF The Stop On Consecutive Filemarks (SOCF) field must be set to 0 for all QIC devices. This field is not changeable.

RBO The Recover Buffer Order (RBO) bit must be set to 0, it is not changeable (the Drive has no RECOVER BUFFERED DATA command).

REW The Report Early Warning (REW) bit must be set to 0, it is not changeable (the Drive does not report Logical Early Warning (LEW) when reading).

Gap Size The Gap Size field must be set to 00h, it is not changeable (the Drive will determine the size of the inter-block gap when writing data).

EOD Defined The EOD Defined field must be set to 00h, it is not changeable (the Drive will use its default EOD definition to detect and generate EOD).

EEG The Enable EOD Generation bit must be set to 1, it is not changeable (the Drive will generate an appropriate EOD area).

SEW The Synchronize at Early Warning (SEW) bit must be set to 1, it is not changeable (the Drive makes sure that any write data, filemarks or setmarks to be transferred to the medium when Logical Early Warning is encountered).

SWP The Software Write Protect (SWP) must be set to 0, it is not changeable (the Drive does not support write protecting in software).

Buffer Size At Early Warning

The Buffer Size At Early Warming must be set to 00h, it is not changeable (the Drive decides the buffer size at Early Warning).

RFTD

Reserved for Tandberg Data use. This bit must be set to zero

14.3.8. Medium Partition Page (1)

This page is used to specify medium partitioning. See also section *2.3 Partitions Within a Volume* for further details.

Note that partitioning is only allowed when the tape is positioned at BOP_0 (the beginning of the first or only partition). After such an operation the tape will again be positioned at BOP_0.

Note also that a partition operation *will erase the data in all existing partitions* if the partitioning specified in the Medium Partition Page(1) differs from the partitioning already on the currently loaded medium. If the partitioning specified equals the partitioning already on the medium, no erase operation will take place.

The page can not be saved.

BYTE	BIT 7	6	5	4	3	2	1	0
00	PS	R	Page Code = 11h					
01	Page Length = 4Eh							
02	Maximum Additional Partitions							
03	Additional Partitions Defined							
04	FDP	SDP	IDP	PSUM		POFM	CLEAR	ADDP
05	Medium Format Recognition							
06	RESERVED				Partition Units			
07	RESERVED							
08 09	Partition Size Descriptor 0							
| |	. . .							
78 79	Partition Size Descriptor 35							

Table 14-19: Medium Partitions Page

PS
The Parameter Savable (PS) bit must be set to zero.

Page Code
This field must be set to 11h.

Page Length
This field must be set to 4Eh (for both SLR and MLR drives).

Maximum Additional Partitions
The MODE SELECT command accepts any value in this field (it is simply ignored). For the MODE SENSE command this field indicates the maximum number of additional partitions supported by the current tape format (as reported by the Density Code field, see the *Block Descriptor List* section under the MODE SENSE command):

Medium Type	Maximum Additional Partitions Supported
Unknown	0
DC9250	0
SLR5	0
SLRtape24	35
SLR32	35
SLRtape40	23
SLRtape7	2
SLRtape50	35
SLRtape60	23
SLRtape75	23
SLRtape100	23
SLRtape140	23

Table 14-20: Maximum Additional Partitions

Additional Partitions Defined

This field indicates how many partitions in addition to the default partition (partition 0) should be created when the IDP bit is set to 1. The maximum number of additional partitions is defined by the Maximum Additional Partitions field. This field is ignored if the IDP bit is set to 0.

The value reported by MODE SENSE indicates how many partitions in addition to the default partition exist on the inserted medium. If the drive is not ready, the Additional Partitions Defined field is undefined.

FDP

A Fixed Data Partitions (FDP) bit of one indicates that the Drive will partition the medium into two fixed sized partitions. The sizes of the partitions are determined by the Drive. When used for QFA, the first partition (partition 0) is the data partition, the second partition (1) is the directory partition. A FDP bit of one is only valid when using a SLRtape140 to SLRtape7 or SLR32 medium. A FDP bit of zero indicates that the Drive will not operate with fixed additional partitions. When setting both the FDP and the IDP bits to zero, the drive will partition the medium with a single partition.

⇨ Legal values are 0 and 1.

⇨ The default (factory programmed) value is 0 (only one partition defined).

SDP

This bit must be set to 0, it is not changeable (the Drive does not support select data partition option).

IDP

An Initiator Defined Partitions (IDP) bit of one indicates that the Drive will partition the medium as defined by the Additional Partitions Defined field and the Partition Size Descriptor fields. An IDP bit of one is only valid when using a SLRtape140 to SLRtape7 or SLR32 medium. An IDP bit of zero indicates that the Drive will not operate with Initiator Defined Partitions.

⇨ Legal values are 0 and 1.

⇨ The default (factory programmed) value is 0 (only one partition defined).

The following table gives a summary of the possible settings of the FDP, SDP and IDP bits:

FDP	SDP	IDP	Resulting Action
0	0	0	The medium is partitioned into a single partition covering the whole medium.
0	0	1	The medium is partitioned according to the supplied Additional Partitions Defined field and the Partition Size Descriptors.
0	1	0	Illegal. Results in CHECK CONDITION status.
0	1	1	Illegal. Results in CHECK CONDITION status.
1	0	0	The medium is partitioned into two partitions. The size of the partitions depends on the medium type.
1	0	1	Illegal. Results in CHECK CONDITION status.
1	1	0	Illegal. Results in CHECK CONDITION status.
1	1	1	Illegal. Results in CHECK CONDITION status.

Table 14-21: Using the FDP, SDP and IDP bits

PSUM

The Partition Size Unit of Measure (PSUM) field is only valid when the IDP bit is set. If the IDP bit is not set this field is ignored. A value of 2 indicates that the unit of the Partition Size Descriptors is MBytes and a value of 3 indicates that the unit of the Partition Size Descriptors is GBytes. The maximum value of a Partition Size Descriptors field is 65535 (FFFFh). This means that the maximum partition size when using PSUM equal to 2 is 65535 Mbytes. Partition sizes greater than 65535 Mbytes must be set by using PSUM equal to 3 and use GBytes as unit in the Partition Size Descriptors.

When the currently mounted volume has a total capacity of 65535 MBytes or less MODE SENSE will always set this field to 2 indicating that the Partition Size Descriptors unit is MBytes. When the total capacity is above 65535 MBytes MODE SENSE will always set this field to 3 indicating that the Partition Size Descriptors unit is GBytes.

POFM

The Partition on Format field must be set to 0, it is not changeable.

CLEAR

This bit must be set to zero to indicate SCSI-2 compatibility.

ADDP

This bit must be set to zero to indicate SCSI-2 compatibility.

Medium Format Recognition

This field must be set to 01h, it is not changeable. This indicates that the Drive is able to independently recognize the format on the medium.

Partition Units

The Partition Unit field must be set to 9 when the PSUM field is set to 3. For all other PSUM values this field is ignored.

Partition Size Descriptors

These fields define the approximate size of the respective partitions in the unit specified in the PSUM field. Partitions are numbered by their relative position in the partition size descriptor list, starting at default partition 0. The size of partition 0 must be greater than 0 and the number of Partition Size Descriptors greater than 0 must be one more than the value of the Additional Partitions Defined field. A partition size descriptor of FFFFh will allocate all remaining space to that partition. If insufficient space exists on the medium for the requested partition sizes or if multiple partition size descriptors are set to FFFFh, the Drive will return CHECK CONDITION status.

All partitions start on track set boundaries at the physical BOT side of the tape and the Partition Size Descriptors will be rounded up accordingly.

For MODE SELECT the Partition Size Descriptors are only valid when the IDP bit is set to 1. If the IDP bit is set to 0, they are ignored.

14.3.9. Informational Exceptions Control Page

This page is used to specify the parameters for the control of TapeAlert specific informational exception conditions.

BYTE	BIT 7	6	5	4	3	2	1	0
00	PS	R	Page Code = 1Ch					
01	Page Length = 0Ah							
02	PERF	RESERVED			DExcpt	TEST	R	LOGErr
03	RESERVED				MRIE			
04 – 07	Interval Timer							
08 – 11	Flag Number							

Table 14-22: Informational Exceptions Control Page

PS The Parameter Savable (PS) bit must be set to zero (this page is not saveable).

Page Code The Page Code for this page must be set to 1Ch.

Parameter Length The Page Length field must always be set to 0Ah.

PERF The Performance (PERF) bit has to be set to 0 to indicate that informational exception operations that may cause delays are acceptable.

DExcpt The Disable Exceptions (DExcpt) bit has to be set to 1 to indicate the drive shall disable all information exception operations and ignore the MRIE field. The host must poll the TapeAlert information Log Page to see if an Informational Exception Condition has occurred.

TEST When the TEST bit is set to 1, the test action is based on the value in the **Test Flag Number** field.

When the TEST bit is set to 0, the drive will not generate any test/false informational exception conditions.

A MODE SENSE command always returns a value of 0 for the TEST bit.

LOGErr The LOG Error (LOGErr) bit has to be set to 0.

MRIE This field has to be set to 0 (not used since DExcpt always is set to 1).

Interval Timer The Interval Timer field has to be set to 0 to indicate that the drive only reports the informational exception condition one time.

Test Flag Number

When the TEST bit is set to 0, the Test Flag Number field must always be set to zero.

When the TEST bit set to 1, and the Test Flag Number field is non-zero, the drive will generate/clear a test informational exception condition. The test action is based on the Test Flag Number value. Valid values of the Test Flag Number are –64 to –1, 1 to 64 and 32767 (7FFFh). Positive numbers will generate the corresponding condition, while negative numbers will clear the corresponding condition. Negative numbers are represented using the 2's complement method. If the Test Flag Number is set to an invalid value, the MODE SELECT command will return CHECK CONDITION, with sense key set to Illegal Request and extended sense set to Invalid Field in Parameter List. A Test Flag Number of zero is illegal with the TEST bit set to 1.

0: This value is illegal and will result in CHECK CONDITION.

1 to 64: Generate an informational exception condition by setting the corresponding TapeAlert flag in the TapeAlert Information log page. Once the TapeAlert flag is set, it is processed normally based on the DExcpt, MRIE, Interval Count and Report Count values. Any real information exception conditions will not be flagged unless the flag is cleared with a new Mode Select, by performing the appropriate corrective action or if the flag is cleared with a Log Select Resetting all Log Parameters.

-1 to –64: Clear an informational exception condition by clearing the TapeAlert flag corresponding to the absolute value of the Test Flag Number. Clearing the flag in this way is equivalent to performing the specified corrective action for that flag, thus allowing a real information exception condition to be set if the real error condition occurs for that flag.

32767: Generate all informational exception conditions supported by the drive by setting all the corresponding supported TapeAlert flags. Once the supported TapeAlert flags are set they are processed the same way as if a single flag was set.

14.3.10. Miscellaneous Parameters Page

This page is used to change values of several vendor unique parameters.

The page can be saved.

BYTE	BIT 7	6	5	4	3	2	1	0
00	PS	R	Page Code = 20h					
01	Page Length = 10h							
02 03	Forced Streaming Count							
04	RESERVED							
05	RESERVED							
06	Load Function							
07	Power-Up Auto Load/Retention Delay							
08	RESERVED			EOWR	R	BSYI	BSYA	FAST
09	LED Function				R	CLN	OND	TIN
10	LEW Position							
11	R	AEPU	RESERVED					
12	RESERVED							
13	Bus Parity Error Retries							
14	Reselection Retries							
15	RESERVED							
16	RESERVED							
17	RESERVED							

Table 14-23: Miscellaneous Page Descriptor

PS The Parameter Savable (PS) bit must be set to zero.

Page Code The Page Code for this page must be set to 20h.

Page Length The Page Length field must always be set to 10h.

Forced Streaming Count The Forced Streaming Count field indicates if the Drive will rewrite the last block to force streaming instead of enter underrun mode and stop the tape when waiting for more data from the Initiator.

A value of zero indicates that the Drive will enter underrun mode when the Drive's data buffer becomes empty during the write operation.

A value different from zero indicates that the Drive will rewrite the last block before entering the underrun mode. The maximum number of rewrites is specified by the Forced Streaming Count field. If a track boundary is encountered, the forced streaming will stop.

⇨ Legal values are numbers in the range 0..65535.

⇨ The default (factory programmed) value is 1024 for SLR50 drives. The default (factory programmed) value is 0 for SLR140, SLR100, SLR75, SLR60 and SLR7 drives.

Load Function

This field controls Auto Load and Auto Retention.

00h : Auto Load
01h : Auto Load, Auto Retension
02h : no Auto Load, no Auto Retension
03h : Auto Load, Conditional Retension
04h : Auto Load and Auto Retension on non-servo formats (SLRtape7, SLR5 and DC9250 media) and Conditional Retension on servo formats (SLRtape140, SLRtape100, SLRtape75, SLRtape60, SLRtape50, SLRtape40, SLR32 and SLRtape24 media).

If Auto Load is enabled the Drive will automatically perform an operation equivalent to a LOAD/UNLOAD command with the Load bit set to one every time a new cartridge is inserted into the Drive.

Note that the Drive will always perform a physical load operation (moving the tape to BOT). When the Load Function is set to 02 (no Auto Load), the physical load is still performed. The media access commands will, however, terminate with CHECK CONDITION until a LOAD/-UNLOAD command (with the Load bit set) has been executed.

If Auto Retension is enabled the Drive will automatically perform an operation equivalent to a LOAD/UNLOAD command with the Load and RET bits set to one every time a new cartridge is inserted into the Drive.

If Conditional Retension is enabled the Drive will automatically perform an operation equivalent to a LOAD/UNLOAD command with the Load and RET bits set to one when such an operation is deemed necessary.

Note that while the Auto Load or Auto Retension executes, the Drive may be ready for commands (depending on the state of the BSYA bit).

⇨ Legal values are numbers in the range 00h..03h.

⇨ The default (factory programmed) value is 00h.

Power-Up Auto Load/Retension Delay

This field specifies the delay that will be applied before mechanical activity (head or capstan motor) is started after Power-Up/Reset; given in increments of 100 ms. This can be used to delay the motor current surges after a Power-Up/Reset condition.

⇨ Legal values are numbers in the range 0..255

⇨ The default (factory programmed) value is 0.

EOWR

When this bit is set the Drive will simulate the TAR (1/2’ reel-to-reel) overwrite feature.

The overwrite function can be used to overwrite data after *the first data block* on the tape or to overwrite *the last of two sequential filemarks* before EOD. See section 2.5 for further details.

⇨ Legal values are 0 and 1.

⇨ The default (factory programmed) value is 0.

BSYI

When set to one, the BSYI bit indicates that the Drive will respond with BUSY status as long as an Immediate-type command is under execution. The BUSY status is returned on every new command until the executing Immediate-type command has completed its execution. When the BSYI bit is set to zero, the first new command will be accepted even if an Immediate-type command is under execution.

(Note: If the Drive is executing a command for another initiator it will respond with BUSY status regardless the setting of the BSYI bit.)

⇨ Legal values are 0 and 1.

⇨ The default (factory programmed) value is 0.

An immediate command is still executing when a new command is received:

Next Command	BSYI = 1	BSYI = 0
Inquiry Request Sense	Execute command	Execute command
Test Unit Ready	BUSY status	Execute command [1]
All other commands	BUSY status	Command waits

Table 14-24: BSYI Usage

As soon as one command is waiting, the drive is in the same state as when a command is executing.

BSYA

When set to one, the BSYA bit indicates that the Drive will respond with BUSY status as long as a drive-initialized (preparation) activity is going on. The BUSY status is returned on every new command until this activity has completed. When the BSYA is set to zero, new commands will be accepted even if the drive is occupied with a drive-initiated (preparation) activity.

⇨ Legal values are 0 and 1

⇨ The default (factory programmed) value is 0.

The drive is busy with a drive-initiated (preparation) activity (as e.g. Autoload) when a new command is received:

Next Command	BSYA = 1	BSYA = 0
Inquiry Request Sense	Execute command	Execute command
Test Unit Ready	CHECK CONDITION status [2]	Execute command [1]
All other commands	BUSY status	Command waits

Table 14-25: BSYA Usage

[1] The command will typically respond with GOOD status.
[2] The error code will be “ Logical Unit In The Process of Becoming Ready”

As soon as one command is waiting, the drive is in the same state as when a command is executing.

FAST

When set to one this bit enables the special FAST space mode. When set to zero this bit disables the FAST space mode. See the SPACE commands for details.

⇨ Legal values are 0 and 1.

⇨ The default (factory programmed) value is 1.

LED Function

This field controls the LED operation. It must be set to zero (0h), it is not changeable (currently the Drive only supports a singled LED mode).

CLN

A Clean (CLN) bit of zero indicates that the drive will not signal CHECK CONDITION when the drive requires cleaning. A CLN bit of one indicates that the drive will signal CHECK CONDITION when the drive requires cleaning. The sense data generated will indicate a Sense Key of 1h (Recovered Error) and ASAQ of 00h 17h (Cleaning Requested). Note that only a single initiator is informed about the cleaning request. This will be the first initiator that issues a command after the cleaning request condition has occurred. The drive signals a cleaning request in these cases:

- When a predetermined tape run length threshold has been reached and the Clean bit (Log Sense, Head Cleaning Page) has a value of 1.
- After a Power Up condition and the Clean bit has a value of 1.
- After a hard reset condition and the Clean bit has a value of 1.
- Each time a CLN bit is changed from 0 to 1 and the Clean bit is 1.
- After an unsuccessful cleaning attempt.

Note that drive will not signal CHECK CONDITION due to a cleaning request until after the current command has completed its execution.

See also the *Head Cleaning* Page of the LOG SENSE command for information regarding the Clean bit and cleaning conditions.

⇨ Legal values are 0 and 1.

⇨ The default (factory programmed) value is 0.

OND

An On-line Diagnostics (OND) bit of zero indicates that the Drive will use a SLRtape24 SL, SLR32 SL, SLRtape50 SL, SLRtape7 SL or SLR40/60/100 - 10GB medium as a diagnostic tape. A diagnostic operation is started automatically when such a tape is inserted into the drive. A OND bit of one indicates that the drive will not start an automatic diagnostic operation when one of the above mentioned cartridge types is inserted.

⇨ Legal values are 0 and 1.

⇨ The default (factory programmed) value is 1.

TIN

A Target Initiated Negotiation (TIN) bit of zero indicates that the Drive does not initiate wide or synchronous data transfer negotiations. A TIN bit of one indicates that the Drive may initiate negotiations for wide and/or synchronous data transfers. The drive does this by transferring a WIDE DATA TRANSFER REQUEST message and/or a SYNCHRONOUS DATA TRANSFER REQUEST message immediately before going to the data-in or date-out phase. The Drive initiates a negotiation only when a previously arranged data transfer agreement may have become invalid (after a reset indication, TARGET RESET message or after a power cycle).

⇨ Legal values are 0 and 1.

⇨ The default (factory programmed) value is 0.

LEW Position

Position of Logical Early Warning tape marker specifies the minimum distance between LEW (Logical Early Warning) and EW (Early Warning). The amount of data can be calculated with the following formula:

LEW Position + (PhysicalBufferSize * 2) *[MBytes]* [1]

Where LEW Position is the numeric input, PhysicalBufferSize is the size of the physical buffer installed in the drive (in megabytes) and the answer is the approximate number of megabytes from LEW to EW. The Drive may add some margins to this number. Note that the distance between LEW and EW will always be limited to the size of a full track/track-set (in this case LEW is placed at the beginning of the last track/track-set).

Note that the amount of data specified by the LEW Position field is *physical data* (i.e. user data plus ECC data plus filler data etc.). Note also that when the LEW marker has been passed the drive enters *unbuffered mode*. This means that filler data may be generated for each new WRITE command. In addition some of the data written after LEW may be subject to rewrites. This all means that the actual amount of user data that may be placed after LEW may vary considerably.

A value of 255 will always place LEW at the beginning of the last track or track set.

⇨ Legal values are numbers in the range 0 and 255.

⇨ The default (factory programmed) value is 0.

AEPU

Auto Eject on Power-Up. The AEPU-bit controls the tape cartridge ejection when powering up the Drive. If this bit is set to one the cartridge will be ejected when power is turned on. When the bit is set to zero the Drive will not eject the tape cartridge when the power is turned on.

⇨ Legal values are 0 and 1.

⇨ The default (factory programmed) value is 0.

---

[1] These values are nominal and will vary with mode of operation.

Bus Parity Error Retries

This field is used to specify the maximum number of consecutive retries of information transfer upon detection of parity error on the data bus or reception of an INITIATOR DETECTED ERROR message for the same bus phase.

- ⇨ Legal values are 0..255, where 0 indicates that there should be no retries and where a value of 255 indicates that there is no limit to the number of retries attempted (the retry sequence must be terminated by the Initiator).
- ⇨ The default (factory programmed) value is 4

Reselection Retries

This field is used to specify the maximum number of reselection retries when the Drive is trying to reconnect to the Host. If the number of retries is exceeded, the command will be aborted..

- ⇨ Legal values are any number in the range 0..255, where values in the range 0..254 indicate a limited number of reselection attempts and the value 255 indicates an infinite number of reselection retries.
- ⇨ The default (factory programmed) value is 4

14.3.11. User Page 0

This page can be used to save any information (up to ten bytes).

The page can be saved.

BYTE	BIT 7	6	5	4	3	2	1	0
00	PS	R	Page Code = 21h					
01	Page Length = 0Ah							
02	User Defined Field							
03	User Defined Field							
04	User Defined Field							
05	User Defined Field							
06	User Defined Field							
07	User Defined Field							
08	User Defined Field							
09	User Defined Field							
10	User Defined Field							
11	User Defined Field							

Table 14-26: User Page 0 Page Descriptor

PS The Parameter Savable (PS) bit must be set to zero.

Page Code The Page Code for this page must be set to 21h.

Page Length The Page Length field must always be set to 0Ah.

User Defined Field These fields can be used to store up to ten bytes of user defined information.

⇨ Any value is legal (no check).

⇨ The default (factory programmed) value is 00h.

14.3.12. User Page 1

This page can be used to save any information (up to ten bytes).

The page can be saved.

BYTE	BIT 7	6	5	4	3	2	1	0
00	PS	R	Page Code = 22h					
01	Page Length = 0Ah							
02	User Defined Field							
03	User Defined Field							
04	User Defined Field							
05	User Defined Field							
06	User Defined Field							
07	User Defined Field							
08	User Defined Field							
09	User Defined Field							
10	User Defined Field							
11	User Defined Field							

Table 14-27: User Page 1 Page Descriptor

PS The Parameter Savable (PS) bit must be set to zero.

Page Code The Page Code for this page must be set to 22h.

Page Length The Page Length field must always be set to 0Ah.

User Defined Field These fields can be used to store up to ten bytes of user defined information.

- ⇨ Any value is legal (no check).
- ⇨ The default (factory programmed) value is 00h.

14.3.13. Cartridge Manufacturer Page

This page holds information on the currently inserted tape cartridge.

This page can NOT be saved. Note that the MODE SELECT command ignores the values given in the Cartridge Manufacturer ID, Production Date Code and Cartridge Serial Number fields (they are changeable).

BYTE	BIT 7	6	5	4	3	2	1	0
00	PS	R	Page Code = 23h					
01	Page Length = 20h							
02 | 09	Cartridge Manufacturer ID							
10	End Of String = 00h							
11	RESERVED							
12 | 19	Cartridge Production Date							
20	End Of String = 00h							
21	RESERVED							
22 | 31	Cartridge Serial Number							
32	End Of String = 00h							
33	RESERVED							

Table 14-28: Cartridge Manufacturer Data Parameters

PS The Parameter Savable (PS) bit must be set to zero.

Page Code The Page Code for this page must be set to 23h.

Page Length The Page Length is set to 20h.

Cartridge Manufacturer ID These bytes hold an ASCII string identifying the Cartridge Manufacturer. If no tape is inserted or if the tape does not hold any manufacturer ID, the MODE SENSE command will return the string “UNKNOWN ” in this field. The string is terminated with a zero (00h) character.

Cartridge Production Date These bytes hold an ASCII string representing the production date for the cartridge. The format is 'DD.MM.YY'. If no tape is inserted or if the tape does not hold any production data code, the MODE SENSE command will return the string “UNKNOWN ” in this field. The string is terminated with a zero (00h) character.

Cartridge Serial Number These bytes hold an ASCII string representing the serial number of the current cartridge. If no tape is inserted or if the tape does not hold any serial number, the MODE SENSE command will return the string “UNKNOWN ” in this field. The string is terminated with a zero (00h) character.

14.4. Exception Handling

See sections on *Error Conditions For All Commands* and *Deferred Errors*.

If the MODE SELECT command, for any reason, returns with CHECK CONDITION status, no parameters will have been changed.

If the PF bit is not set to one and the parameter list contains one or more pages, the MODE SELECT command will return CHECK CONDITION status. No parameter data will be transferred. The Error Code will be set to PARAMETER LIST LENGTH ERROR.

A Parameter List Length that results in truncation of any Descriptor, Header or Page of parameters will cause the Drive to terminate the command with CHECK CONDITION status. The Error Code will be set to PARAMETER LIST LENGTH ERROR.

If a Page Code in the Parameter List is not in the legal set of values, the Drive will terminate the MODE SELECT command with CHECK CONDITION status. The Error Code will be set to INVALID FIELD IN PARAMETER LIST.

If the Page Length in any page is wrong, the Drive will terminate the MODE SELECT command with CHECK CONDITION status. The Error Code will be set to INVALID FIELD IN PARAMETER LIST.

If any field in the Parameter List is set to an illegal value, the Drive will terminate the MODE SELECT command with CHECK CONDITION status. The Error Code will be set INVALID FIELD IN PARAMETER LIST.

If any non-changeable pages or any non-changeable fields in any page are specified for change, the Drive will terminate the MODE SELECT command with CHECK CONDITION status. The Error Code will be set to INVALID FIELD IN PARAMETER LIST.

If any non-savable pages are specified when the SP bit is set, the Drive will terminate the MODE SELECT command with CHECK CONDITION status. The Error Code will be set INVALID FIELD IN PARAMETER LIST.

14.5. Phase Sequencing

In this section the possible SCSI-bus phase sequences during execution of the command are described. Section 3.2.1 has more details about the generic phases in the brackets.

<sequence 1> := <initiator-part> <message-out> <command><disconnect> <reconnect> <data-out><disconnect><reconnect> <completed>

The Drive will disconnect when the CDB has been transferred. The Drive will then reconnect and transfer the mode parameters. When the parameters are transferred the Drive will disconnect again. Finally, when the mode parameters are handled, status is reported.

15. Mode Sense

15.1. Command Description

The MODE SENSE command provides a means for the Drive to report parameters to the Initiator. It is a complementary command to the MODE SELECT command.

The Drive will implement only one common set of parameters for all Initiators.

The MODE SENSE parameter list will be returned during the DATA IN phase of the command.

When page format is used the MODE SENSE command may return 4 different types of parameters; current values, changeable values, default values or saved values.

Current Values

The current values are the values under which the Drive is presently configured for the page specified. The current values returned are:

1) The parameters set in the last successful MODE SELECT command.

2) The saved values if a MODE SELECT command has not been executed since the last power-up, RESET condition or TARGET RESET message.

3) The factory saved values if a MODE SELECT command has never been executed with the save parameter (SP) bit set.

Changeable Values

The page requested will be returned containing information that indicates which fields are changeable. Parameters that are changeable will be set to one. Parameters that are not changeable will be set to zero. If any part of a field is changeable all bits in that field will be set to one. If none of the parameters are changeable within a page, the Page Length value will be set to zero.

Default Values

The default values are set once and for all in the Drive's production line. Parameters not supported by the Drive will be set to zero.

Saved Values

The saved values are the values saved by the last successful MODE SELECT command with the save parameter (SP) set or the default values if no MODE SELECT with the SP bit has never been executed. Saved values are located in the EEPROM. Parameters not supported by the Drive will be set to zero.

15.2. Command Descriptor Block

BYTE	BIT 7	6	5	4	3	2	1	0
00	Operation Code **1Ah**							
01	Logical Unit Number (LUN)			R	DBD	RESERVED		
02	PC		Page Code					
03	RESERVED							
04	Allocation Length							
05	Control Byte							

Table 15-1: MODE SENSE Command Descriptor Block

DBD

A Disable Block Descriptor (DBD) bit of one indicates that the Block Descriptor List will not be transferred to the Initiator. A DBD bit of zero indicates that the Block Descriptor List will be transferred following the Header List.

PC

The page control (PC) field defines the type of parameter values to be returned.

0 : Return current values
1 : Return changeable values
2 : Return default values
3 : Return saved values

Page Code

The page code specifies which page(s) to return.

⇨ Legal values are 00h, 01h, 02h, 0Ah, 0Fh, 10h, 11h, 1Ch, 20h, 21h, 22h, 23h and 3Fh [1].

Page Code 00h is returning the Header List followed by the Block Descriptor List - a total of 12 bytes. When selecting Page Code 00h the DBD bit is ignored.

See the MODE SELECT command for a description of the various pages.

Allocation Length

This field specifies the maximum number of bytes that the Initiator has allocated for the returned MODE SENSE data. An Allocation Length of zero indicates that no MODE SENSE data will be sent. The Drive terminates the DATA-IN phase when Allocation Length bytes have been transferred or when all available MODE SENSE data have been transferred, whichever is less.

[1] The special page code 3Fh can be used to have the Drive return all its page descriptors.

15.3. Parameter List

The MODE SENSE parameter list consists of three sub-lists. The first list is a 4 byte Header List. This may be followed by an 8 byte Block Descriptor List. At last there may be from one to seven Page Descriptor Lists.

15.3.1. Header List

BYTE	BIT 7	6	5	4	3	2	1	0
00	Sense Data Length							
01	Medium Type							
02	WP	Buffered Mode			Tape Speed			
03	Block Descriptor Length							

Table 15-2: MODE SENSE Header List

Sense Data Length This field specifies the length in bytes of the following MODE SENSE data (the Sense Data Length byte itself is not included) that is available to be transferred during the DATA IN phase

Medium Type This field will indicate the type of cartridge inserted into the Drive.

Possible cartridge types are:

00h :	UNKNOWN	**47h :**	SLRtape50
02h :	DC300 or DC300XLP [1]	**50h :**	SLRtape50 SL
04h :	DC615 or DC600A [1]	**54h :**	SLR32 SL
06h :	DC6037, DC6150 or DC6250 [1]	**55h :**	SLR5
08h :	DC6320 or DC6525 [1]	**56h :**	SLR5 SL
24h :	DC9100 [1]	**63h :**	SLRtape7
25h :	DC9120 [1]	**64h :**	SLRtape7 SL
26h :	DC9120SL [1]	**65h :**	SLRtape24
30h :	DC9100FW [1]	**66h :**	SLRtape24 SL
31h :	DC9200SL	**70h :**	SLRtape140
33h :	MLR1-26GB	**73h :**	SLRtape40
34h :	DC9200	**74h :**	SLRtape60
35h :	DC9120XL [1]	**74h :**	SLRtape75
40h :	DC9250	**75h :**	SLRtape100
43h :	SLR32	**76h :**	SLR40/60/100 - 10GB
44h :	MLR1-26GBSL		

WP The Write Protect (WP) bit of zero indicates that the cartridge is write enabled. A WP bit of one indicates that the cartridge is write protected.

[1] The Drive is able to recognize this medium type, but as the tape format used on this type is not supported, the Drive will not allow any read or write operations as long as this medium is inserted. See also the note regarding the use of 550 Oe tapes in section 14.3.2. Block Descriptor List under Density Code.

Buffered Mode

The Drive supports the following mode: 0 and 1. Mode 0 indicates that the WRITE and WRITE FILEMARKS command reports GOOD status when the requested data blocks have been actually written and verified (read-after-write checked). Mode 1 indicates that the WRITE and WRITE FILEMARKS command reports GOOD status as soon as the requested data has been transferred into the Drive's data buffer

Tape Speed

This field specifies the current tape speed. The following values are legal:

0h : Default speed
1h : Low speed
2h : Medium speed
3h : High speed

See the MODE SELECT command for further details about tape speed and the resulting data rates.

Block Descriptor Length

This field specifies the length in bytes of the block descriptor list. If the block descriptor list is transferred (DBD-bit = 0), the Block Descriptor Length is set to 8. If the block descriptor list is not transferred (DBD-bit = 1), the Block Descriptor Length is set to 0.

15.3.2. Block Descriptor List

BYTE	BIT 7	6	5	4	3	2	1	0
00	Density Code							
01 02 03	Number of Blocks							
04	RESERVED							
05 06 07	Block Size							

Table 15-3: MODE SENSE Block Descriptor List

Density Code

This field indicates the current operating tape format. The Density Code value returned in response to a MODE SENSE command will be as described below:

- *The density code is set to the principal density code when the Drive has reported Unit Attention due to power up or hard reset or when the density of a newly inserted cartridge is not yet determined. The principal density code is the highest supported density supported by the Drive.*

SLR7	The highest supported density is ALRF-2
SLR50	The highest supported density is MLR3
SLR60	The highest supported density is ALRF-1
SLR75	The highest supported density is ALRF-1
SLR100	The highest supported density is ALRF-1
SLR140	The highest supported density is ALRF-6

- *When a successful read/space type command has been performed the Density Code will be automatically updated to reflect the format on the tape just read/written.*

Possible Density Codes are:

00h : Unknown
21h : QIC-5010-DC tape format
22h : QIC-2GB-DC tape format
26h : QIC-4GB-DC tape format
30h : MLR3 tape format
32h : ALRF-2 tape format
33h : SLR6 tape format
34h : ALRF-1 tape format
36h : ALRF-6 tape format

Number Of Blocks

This field will always be set to zero to indicate that the whole tape has the same density code.

Block Size

This field reports the currently configured fixed block size. See the corresponding field in the MODE SELECT command for details.

15.3.3. Read-Write Error Recovery Page Descriptor

See the MODE SELECT command for details on the current, saved and default values of this page (Page Code 01h)

The PS bit will be set to one for this page.

The Changeable Values page will return the following values:

Byte 00	:	81h	
Byte 01	:	0Ah	
Byte 02	:	01h	The DCR is changeable
Byte 03	:	FFh	Read Retry Count is changeable
Byte 04	:	00h	
Byte 05	:	00h	
Byte 06	:	00h	
Byte 07	:	00h	
Byte 08	:	FFh	The Write Retry Count is changeable
Byte 09	:	00h	
Byte 10	:	00h	
Byte 11	:	00h	

15.3.4. Disconnect/Reconnect Page Descriptor

See the MODE SELECT command for details on the current, saved and default values of this page (Page Code 02h)

The PS bit will be set to one for this page.

The Changeable Values page will return the following values:

Byte 00	:	82h	
Byte 01	:	0Eh	
Byte 02	:	FFh	The Read Buffer Full Ratio is changeable
Byte 03	:	FFh	The Write Buffer Empty Ratio is changeable
Byte 04	:	00h	
Byte 05	:	00h	
Byte 06	:	00h	
Byte 07	:	00h	
Byte 08	:	00h	
Byte 09	:	00h	
Byte 10	:	FFh	The Maximum Burst Size is changeable
Byte 11	:	FFh	
Byte 12	:	00h	
Byte 13	:	00h	
Byte 14	:	00h	
Byte 15	:	00h	

15.3.5. Control Mode Page

See the MODE SELECT command for details on the current, saved and default values of this page (Page Code 0Ah)

The PS bit will be set to zero for this page.

The Changeable Values page will return the following values:

Byte 00	:	0Ah	
Byte 01	:	0Ah	
Byte 02	:	01h	The RLEC bit is changeable
Byte 03	:	00h	
Byte 04	:	00h	
Byte 05	:	00h	
Byte 06	:	00h	
Byte 07	:	00h	
Byte 08	:	00h	
Byte 09	:	00h	
Byte 10	:	00h	
Byte 11	:	00h	

15.3.6. Data Compression Page Descriptor

See the MODE SELECT command for details on the current, saved and default values of this page (Page Code 0Fh)

The PS bit will be set to one for this page.

The Changeable Values page will return the following values:

Byte 00	:	8Fh	
Byte 01	:	0Eh	
Byte 02	:	80h	The DCE bit is changeable
Byte 03	:	E0h	The DDE bit and the RED field is changeable
Byte 04	:	FFh	The Compression Algorithm is changeable
Byte 05	:	FFh	
Byte 06	:	FFh	
Byte 07	:	FFh	
Byte 08	:	FFh	The Decompression Algorithm is changeable
Byte 09	:	FFh	
Byte 10	:	FFh	
Byte 11	:	FFh	
Byte 12	:	00h	
Byte 13	:	00h	
Byte 14	:	00h	
Byte 15	:	00h	

15.3.7. Device Configuration Parameters Page Descriptor

See the MODE SELECT command for details on the current, saved and default values of this page (Page Code 10h)

The PS bit will be set to one for this page.

The Changeable Values page will return the following values:

Byte 00	:	90h	Page Code
Byte 01	:	0Eh	Page Length
Byte 02	:	40h	The CAP bit is changeable
Byte 03	:	FFh	The Active Partition field is changeable
Byte 04	:	00h	
Byte 05	:	00h	
Byte 06	:	FFh	The Write Delay Time is changeable
Byte 07	:	FFh	
Byte 08	:	10h	The AVC bit is changeable
Byte 09	:	00h	
Byte 10	:	00h	
Byte 11	:	00h	
Byte 12	:	00h	
Byte 13	:	00h	
Byte 14	:	01h	The RFTD bit is changeable
Byte 15	:	00h	

15.3.8. Medium Partition Parameters Page Descriptor

See the MODE SELECT command for details on the current, saved and default values of this page (Page Code 11h)

The PS bit will be set to zero for this page.

The Changeable Values page will return the following values:

Byte 00	:	11h	
Byte 01	:	4Eh	
Byte 02	:	FFh	The Maximum Additional Partitions is changeable
Byte 03	:	FFh	The Additional Partitions Defined is changeable
Byte 04	:	B8h	The FDP, IDP and PSUM fields are changeable
Byte 05	:	00h	
Byte 06	:	0Fh	The Partition Unit is changeable
Byte 07	:	00h	
Byte 08	:	FFh	The Partition Size Descriptor 0 is changeable
Byte 09	:	FFh	The Partition Size Descriptor 1 is changeable
...			
Byte 78	:	FFh	The Partition Size Descriptor 34 is changeable
Byte 79	:	FFh	The Partition Size Descriptor 35 is changeable

15.3.9. TapeAlert Configuration Page

See the MODE SELECT command for details on the current, saved and default values for of this page (PageCode 1Ch)

The PS bit will always be set to zero for this page to indicate that the page is not saveable.

The Changeable Values page will return the following values:

Byte 00	:	1Ch	
Byte 01	:	0Ah	
Byte 02	:	04h	Test bit
Byte 03	:	00h	
Byte 04	:	00h	
Byte 05	:	00h	
Byte 06	:	00h	
Byte 07	:	00h	
Byte 08	:	FFh	Test Flag Number
Byte 09	:	FFh	---------- " -----------
Byte 10	:	FFh	---------- " -----------
Byte 11	:	FFh	---------- " -----------

15.3.10. Miscellaneous Parameters Page Descriptor

See the MODE SELECT command for details on the current, saved and default values of this page (Page Code 20h)

The PS bit will be set to one for this page.

The Changeable Values page will return the following values:

Byte 00	:	A0h	
Byte 01	:	10h	
Byte 02	:	FFh	The Forced Streaming Count is changeable
Byte 03	:	FFh	-”-
Byte 04	:	00h	
Byte 05	:	00h	
Byte 06	:	FFh	The Load Function is changeable
Byte 07	:	FFh	The Power-Up/Reset Load-Delay is changeable
Byte 08	:	17h	The EOWR, BSYI, BSYA and FAST bits are changeable
Byte 09	:	F7h	The LED Function, CLN, OND and TIN bits are changeable
Byte 10	:	FFh	The LEW position is changeable
Byte 11	:	40h	The AEPU bit is changeable
Byte 12	:	00h	
Byte 13	:	FFh	The Bus Parity Error Retries is changeable.
Byte 14	:	FFh	The Selection Retries is changeable.
Byte 15	:	00h	
Byte 16	:	00h	
Byte 17	:	00h	

15.3.11. User Page 0 Page Descriptor

See the MODE SELECT command for details on the current, saved and default values of this page (Page Code 21h)

The PS bit will be set to one for this page.

The Changeable Values page will return the following values:

Byte 00	:	A1h	
Byte 01	:	0Ah	
Byte 02	:	FFh	All Bytes are changeable
Byte 03	:	FFh	
Byte 04	:	FFh	
Byte 05	:	FFh	
Byte 06	:	FFh	
Byte 07	:	FFh	
Byte 08	:	FFh	
Byte 09	:	FFh	
Byte 10	:	FFh	
Byte 11	:	FFh	

15.3.12. User Page 1 Page Descriptor

See the MODE SELECT command for details on the current, saved and default values of this page (Page Code 22h)

The PS bit will be set to one for this page.

The Changeable Values page will return the following values:

Byte 00	:	A2h	
Byte 01	:	0Ah	
Byte 02	:	FFh	All Bytes are changeable
Byte 03	:	FFh	
Byte 04	:	FFh	
Byte 05	:	FFh	
Byte 06	:	FFh	
Byte 07	:	FFh	
Byte 08	:	FFh	
Byte 09	:	FFh	
Byte 10	:	FFh	
Byte 11	:	FFh	

15.3.13. Cartridge Manufacturer Page

See the MODE SELECT command for details on the current, saved and default values of this page (Page Code 23h)

The PS bit will be set to zero for this page.

The Changeable Values page will return the following values:

Byte 00	:	23h	
Byte 01	:	20h	
Byte 02	:	FFh	The Cartridge Manufacturer ID field is changeable
Byte 03	:	FFh	
Byte 04	:	FFh	
Byte 05	:	FFh	
Byte 06	:	FFh	
Byte 07	:	FFh	
Byte 08	:	FFh	
Byte 09	:	FFh	
Byte 10	:	00h	
Byte 11	:	00h	
Byte 12	:	FFh	The Production Date Code field is changeable
Byte 13	:	FFh	
Byte 14	:	FFh	
Byte 15	:	FFh	
Byte 16	:	FFh	
Byte 17	:	FFh	
Byte 18	:	FFh	
Byte 19	:	FFh	
Byte 20	:	00h	
Byte 21	:	00h	
Byte 22	:	FFh	The Cartridge Serial Number field is changeable
Byte 23	:	FFh	
Byte 24	:	FFh	
Byte 25	:	FFh	
Byte 26	:	FFh	
Byte 27	:	FFh	
Byte 28	:	FFh	
Byte 29	:	FFh	
Byte 30	:	FFh	
Byte 31	:	FFh	
Byte 32	:	00h	
Byte 33	:	00h	

15.4. Exception Handling

See sections on *Error Conditions For All Commands* and *Deferred Errors*.

If the PF bit is not set to one, the MODE SENSE command will be terminated with CHECK CONDITION status. The Error Code will be set to INVALID FIELD IN CDB.

If the Page Code is not in the range of legal values, the MODE SENSE command will be terminated with CHECK CONDITION status. The Error Code will be set to INVALID FIELD IN CDB.

15.5. Phase Sequencing

In this section the possible SCSI-bus phase sequences during execution of the command are described. Section 3.2.1 has more details about the generic phases in the brackets.

<sequence 1> := <initiator-part> <message-out> <command> <data-in> <completed>

This sequence will be used when the MODE SENSE command does not follow an Immediate type command.

<sequence 2> := <initiator-part> <message-out> <command> <disconnect> <reconnect> <data-in> <completed>

This sequence will be used when the MODE SENSE command follows an Immediate type command. The Drive will disconnect when the CDB has been transferred. The Drive will reconnect when the previous Immediate command has completed execution.

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16. Prevent/Allow Medium Removal

16.1. Command Description

This command is used to enable/disable the eject mechanism. The Drive does not allow medium removal if any initiator currently has medium removal prevented.

Medium removal will be prevented when any Initiator issues a PREVENT MEDIUM REMOVAL command with the PREV-bit set to one. The PREVENT condition can only be cleared by the Initiator that originated the command. It cannot be cleared by any other Initiator sending an ALLOW command. While the prevention of media removal is effective, the Drive will inhibit the eject mechanism that allows removal of the medium by an operator or by the UNLOAD command.

It is not an error to attempt to allow medium removal when medium removal is not currently prevented by this initiator. It is neither an error to attempt to allow medium removal when medium removal currently is prevented by another initiator. The command will be ignored and terminated with GOOD status. If another initiator has prevented medium removal, the PREVENT condition is still valid.

A PREVENT ALLOW MEDIUM REMOVAL command (with a PREV bit of zero) will be executed even if the Drive is currently reserved by another Initiator.

If disconnection is allowed, the Drive will disconnect when executing this command.

16.2. Command Descriptor Block

BYTE	BIT 7	6	5	4	3	2	1	0
00	Operation Code **1Eh**							
01	Logical Unit Number (LUN)			RESERVED				
02	RESERVED							
03	RESERVED							
04	RESERVED							PREV
05	Control Byte							

Table 16-1: PREVENT/ALLOW MEDIUM REMOVAL Cdb

PREV

A Prevent (PREV) bit of one disables the eject mechanism. The Drive will not eject the tape following an UNLOAD command or when the Unload button is pushed. When it receives UNLOAD, the drive unloads the tape but leaves it in the mechanism. The Unload button is disabled.

A PREV bit of zero enables the eject mechanism. The Drive ejects the tape following completion of an UNLOAD. The Unload button is also reenabled.

16.3. Exception Handling

See sections on *Error Conditions For All Commands*, *Deferred Errors* and Error Conditions For Media Access Commands.

16.4. Phase Sequencing

In this section the possible SCSI-bus phase sequences during execution of the command are described. Section 3.2.1 has more details about the generic phases in the brackets.

<sequence 1> := <initiator-part> <message-out> <command> <disconnect> <reconnect> <completed>

This sequence will be used when the PREVENT/ALLOW MEDIA REMOVAL command is executed and host does allow disconnection. The Drive will disconnect when the CDB has been transferred. The Drive will reconnect when the PREVENT/ALLOW MEDIA REMOVAL command has completed execution.

<sequence 2> := <initiator-part> <message-out> <command> <completed>

This sequence will be used when the PREVENT/ALLOW MEDIA REMOVAL command is executed and host does not allow disconnection.

17. Read

17.1. Command Description

The READ command transfers one or more blocks to the Initiator beginning with the next block on the tape.

The Fixed (FIX) bit specifies both the meaning of the Transfer Length field and whether fixed-length or variable length block(s) are to be transferred. The data read will be returned during the DATA-IN phase of the command.

When the FIX bit is set to zero, the Drive is requested to transfer a single variable length data block. The Transfer Length specifies the block length in number of bytes. The block length found on the tape is expected to be equal to the specified block length.

When the FIX bit is set to one, the Drive is requested to transfer a number of fixed length blocks. The Transfer Length specifies the number of blocks to transfer. All the blocks are expected to be of the same length. The length expected is the length reported by the MODE SENSE command (the Block Size field of the Block Descriptor List). Note that a FIX bit of one is not legal when the Drive has been set into Variable Block mode. Variable Block mode is in effect when the Block Size field in the Block Descriptor List of the MODE SELECT command is set to zero (000000h). See the MODE SELECT command for further details.

If the requested Transfer Length is zero, the Drive will transfer no data and the logical tape position will not be changed. This will not be considered an error.

If the READ command is the first media access command executed on a newly inserted cartridge, the read operation will start from BOP. If the partition number is not explicitly changed, the Drive will start reading on partition zero. If the READ command follows an ERASE, LOAD/UNLOAD (with Load bit set to one) or REWIND command, the read operation will also start from BOP. Refer to the corresponding command description for the partition number. If the READ command follows a LOCATE, SPACE, VERIFY[1] or another READ command, the read operation will start with the next block on the tape.

Upon termination of a successful READ command, the logical tape position will be after the last block (fixed or variable) read (end-of-media side).

If disconnection is allowed, the Drive will disconnect when executing this command.

---

[1] VERIFY is not supported by SLR7 and SLR140

17.2. Command Descriptor Block

BYTE	BIT 7	6	5	4	3	2	1	0
00	Operation Code **08h**							
01	Logical Unit Number (LUN)			RESERVED			SILI	FIX
02	Transfer Length							
03								
04								
05	Control Byte							

Table 17-1: READ Command Descriptor Block

SILI

A Suppress Incorrect Length Indicator (SILI) bit of zero indicates that CHECK CONDITION is reported if an incorrect length block is read.

A SILI bit of one indicates that CHECK CONDITION is not reported in certain cases even if an incorrect block is read. See section *17.3.4. Illegal Length* for details.

FIX

A Fixed (FIX) bit of zero indicates that a single block will be transferred with the Transfer Length specifying the maximum number of bytes the Initiator has allocated for the returned data. A FIX bit of one indicates that the Transfer Length specifies the number of blocks to be transferred to the Initiator.

Note that certain combinations of the SILI bit, FIX bit and the value of the Block Size field in the MODE SELECT Block Descriptor is not legal. See section *17.3.4.3. Illegal Length Summary* for details.

Transfer Length

This field specifies the number of bytes or blocks requested for transfer. Any value in the range 0..16777215 is legal[1].

[1] The maximum block size that can be written is 262144 bytes.

17.3. Exception Handling

17.3.1. General

See sections on *Error Conditions For All Commands*, *Deferred Errors*, *Error Conditions For Media Access Commands* and *Buffer Parity Errors*.

When the READ command has started to execute, all detected errors will set the VADD bit and the Information Bytes will hold the difference between the requested and the actual Transfer Length. See the following sections for details.

If the FIX bit is one and the Drive is in Variable Block mode, the READ command will be terminated with CHECK CONDITION. The Error Code will be set to INVALID FIELD IN CDB. No data will be transferred.

If both the SILI and the FIX bits are one, the Drive will terminate the READ command with CHECK CONDITION status. The Error Code will be set INVALID FIELD IN CDB.

17.3.2. No Data

If the Drive is not able to find data on the inserted cartridge the READ command will be terminated with CHECK CONDITION. When using a SLRtape140, SLRtape100, SLRtape75, SLRtape60, SLRtape50, SLRtape40, SLR32 or SLRtape24 medium the Error Code will be End-of-data detected. When using a SLRtape7, SLR5 or DC9250 medium there are two possible error codes. If the medium is physically blank (bulk erased etc.) the Error Code will be End-of-Data Detected or Recorded entity not found. Otherwise the Error Code will be End-of-data detected. In any case the Valid (VADD) bit in the sense data list will be set to one. The Information Bytes will be set equal to the requested Transfer Length.

17.3.3. Tapemark Detected

If a tapemark (Filemark or Setmark) is encountered during execution of a READ command, the command will transfer all data up to the tapemark. The READ command will then be terminated with CHECK CONDITION status. If a Filemark is encountered, the Error Code is set to FILEMARK DETECTED. If a Setmark is encountered, the Error Code is set to SETMARK DETECTED. For both errors the Filemark (FMK) bit and the Valid (VADD) bit in the sense data list will be set to one. The Information Bytes will be set to the difference (residue) between the requested Transfer Length and the actual transfer length (bytes or blocks). For variable length reads the Information Bytes will be set equal to the Transfer Length (because a tapemark block was found instead of a data block and no data was transferred). When the command has terminated, the logical tape position will be located after the tapemark (end-of-media side).

17.3.4. Illegal Length

When the requested transfer length does not match the actual block length, the Drive response depends on the state of the FIX bit, SILI bit and on the value of the Block Size field in the MODE SELECT Block Descriptor List.

17.3.4.1. FIX Bit Set to ZERO

If the actual block length (length of block found on the tape) is smaller than the requested Transfer Length, only the actual block length is transferred. If the actual block length is larger than the requested Transfer Length, only the requested length is transferred.

SILI Bit Is Set To Zero:

If the SILI bit is zero, the READ command will be terminated with CHECK CONDITION status if the requested transfer length does not match the actual block length. The Error Code will be set to NO ADDITIONAL SENSE INFORMATION, ILLEGAL LENGTH BLOCK READ. The illegal length indicator (ILI) and Valid (VADD) bits in the sense data list will be set to one. The Information Bytes will be set to the requested Transfer Length minus the actual block length. This means that the Information Bytes indicate the residual length. If the actual block length was smaller than the specified length, the residual will be a positive number. If the actual block length was larger than the specified length, the residual will be a negative number. Negative residues will be presented on 2's complement form. When the command has terminated, the logical tape position will be located after the incorrect length block (end of partition side).

SILI Bit Is Set To One:

When the SILI bit is one, the Drive will not return CHECK CONDITION status if the only error is that the Transfer Length *exceeds* the actual block length recorded on the tape. When the command has terminated, the logical tape position will be located after the incorrect length block (end of partition side).

When the SILI bit is one and the only error is that the Transfer Length is *less* then the actual block length recorded on the tape, the behavior depends on the current *Fixed* or *Variable Block* mode:

- Fixed Block Mode

  When the Block Size field in the Block Descriptor List of the MODE SELECT command is different from zero (*Fixed Block* mode), the READ command will then be terminated with CHECK CONDITION status if the Transfer Length is less then the actual block length recorded on the tape even if the SILI bit is set to one. The Error Code will be set to NO ADDITIONAL SENSE INFORMATION, ILLEGAL LENGTH BLOCK READ. The illegal length indicator (ILI) and Valid (VADD) bits in the sense data list will be set to one. The Information Bytes will be set to the requested Transfer Length minus the actual block length (a negative number). This means that the absolute value of the Information Bytes indicates the number of byte **not** transferred from the block read. When the command has terminated, the logical tape position will be located after the incorrect length block (end of partition side).

- Variable Block Mode

  When the Block Size field in the Block Descriptor List of the MODE SELECT command is set to zero (*Variable Block* mode), a SILI bit of one indicates that the Drive will not return CHECK CONDITION status if the only error is that the Transfer Length does not match the actual block length recorded on the tape. When the command has terminated, the logical tape position will be located after the incorrect length block (end of partition side).

17.3.4.2. FIX Bit Set to ONE

If the actual block length (length of block found on the tape) is smaller than the configured Block Size (see MODE SELECT command), only the actual block length is transferred. If the actual block length is larger than the configured Block Size, only the configured Block Size is transferred.

The READ command will then be terminated with CHECK CONDITION status. The Error Code will be set to NO ADDITIONAL SENSE INFORMATION, ILLEGAL LENGTH BLOCK READ. The illegal length indicator (ILI) and Valid (VADD) bits in the sense data list will be set to one. The Information Bytes will be set to the requested Transfer Length minus the actual number of blocks transferred (not including the incorrect length block). The block with the unexpected length is not counted among the transferred blocks. When the command has terminated, the logical tape position will be located after the incorrect length block (end of partition side).

17.3.4.3. Illegal Length Summary

The table shown below summarizes the illegal length handling. The Illegal Length Type column shows *Underlength* when the Transfer Length is *larger* than the actual block length. The Illegal Length Type column shown *Overlength* when the Transfer Length is *less* than the actual block length.

FIX	SILI	Block Size	Illegal Length Type	Result
0	0	0	Underlength	CHECK CONDITION, *Information Bytes > 0 (positive)*
			Overlength	CHECK CONDITION, *Information Bytes < 0 (negative)*
0	0	> 0	Underlength	CHECK CONDITION, *Information Bytes > 0 (positive)*
			Overlength	CHECK CONDITION, *Information Bytes < 0 (negative)*
0	1	0	Underlength	GOOD
			Overlength	GOOD
0	1	> 0	Underlength	GOOD
			Overlength	CHECK CONDITION, *Information Bytes < 0 (negative)*
1	0	0	-	CHECK CONDITION, **Illegal Request**
			-	CHECK CONDITION, **Illegal Request**
1	0	> 0	Underlength	CHECK CONDITION, *Information Bytes < 0 (negative)*
			Overlength	CHECK CONDITION, *Information Bytes < 0 (negative)*
1	1	0	-	CHECK CONDITION, **Illegal Request**
			-	CHECK CONDITION, **Illegal Request**
1	1	> 0	-	CHECK CONDITION, **Illegal Request**
			-	CHECK CONDITION, **Illegal Request**

Table 17-2: Illegal Length Summary

17.3.5. End of Data

If end-of-data (EOD) is encountered during execution of the READ command, the command will transfer all data blocks up to the end-of-data marker. The READ command will then be terminated with CHECK CONDITION status. The Sense Key will be set to BLANK CHECK. Additionally the Error Code and the End Of Media (EOM) bit will be set as follows:

- If end-of-data is encountered before the early warning (EW) tape marker on the last track set of the current partition, the Drive will set the Error Code to END-OF-DATA DETECTED and the EOM bit to zero.

- If end-of-data is encountered at or after the early warning (EW) tape marker on the last track set of the current partition, the Drive will set the Error Code to END-OF-PARTITION/MEDIUM DETECTED ON READ, PHYSICAL END REACHED and the EOM bit to one (note however that even if end-of-partition was indicated during write, the drive may detect end-of-data both immediately before or after the early warning (EW) tape marker during a subsequent read operation).

In any case the Valid (VADD) bit in the sense data list will be set to one. The Information Bytes will be set to the difference (residue) between the requested Transfer Length and the actual transfer length (bytes or blocks). When the command has terminated, the logical tape position will be located after the last block transferred to the Initiator.

When a variable length block has been abnormally truncated, due to an end-of-data detection, Illegal Length is not signaled. Instead the end-of-data detected error takes priority and the Error Code is set END-OF-DATA DETECTED.

17.3.6. End of Partition

If end-of-partition (EOP) is encountered during execution of the READ command, the command will transfer all data blocks up to end-of-partition. The READ command will then be terminated with CHECK CONDITION status. The Error Code will then be set to END-OF-PARTITION/MEDIUM DETECTED ON READ, PHYSICAL END REACHED and the Sense Key will be set to MEDIUM ERROR. The End Of Media (EOM) and Valid (VADD) bits in the sense data list will be set to one. The Information Bytes will be set to the difference (residue) between the requested Transfer Length and the actual transfer length (bytes or blocks). When the command has terminated, the logical tape position is undefined and all new READ, LOCATE or SPACE commands will be terminated immediately with CHECK CONDITION as if they just ran into end-of-partition.

When a variable length block has been truncated, due to an end-of-partition detection, Illegal Length is not signaled. Instead the end-of-partition error takes priority and the Error Code is set to END-OF-PARTITION/MEDIUM DETECTED ON READ, PHYSICAL END REACHED.

17.3.7. Non-Recoverable Read Error

If a non-recoverable read error occurs during the execution of a READ command, the Drive will transfer all good data up to the non-recoverable physical tape block. The Drive will then terminate the READ command with CHECK CONDITION status. The Error Code will be set to READ RETRIES EXHAUSTED. The Valid (VADD) bit in the sense data list will be set to one. The Information Bytes will be set to the difference (residue) between the requested Transfer Length and the actual transfer length.

When the command has terminated, the logical tape position will be located before the non-recoverable *physical* tape block. A READ POSITION command will report a position corresponding to the *next* logical block (as if the logical block with the non-recoverable error has been passed).

When READ RETRIES EXHAUSTED has been reported the Drive will only accept the following media access commands:

- LOAD and REWIND
- SPACE with a space code of *Space Over Bad Blocks*.
- READ

When the Drive receives a new READ command the Drive will execute a Space Over Bad Blocks operation to move the logical tape position until it can safely detect the beginning of a logical block. This READ command will not transfer any data and it will be terminated with another CHECK CONDITION status (indicating READ RETRIES EXHAUSTED). Yet another READ command will start transferring data from this logical block.

If there are more non-recoverable errors in the next logical block also, good data is again transferred up to the first error, CHECK CONDITION is reported and the whole process described above is repeated.

17.3.8. Illegal Termination

When the Drive can see no more data on a tape, it always checks that the last block is followed by an end-of-data marker before reporting End Of Data (Blank Check). If the end-of-data marker is not found, the READ command is terminated with CHECK CONDITION status. The Error Code will be set to READ RETRIES EXHAUSTED. The Valid (VADD) bit in the sense data list will be set to one. The Information Bytes will be set to the difference (residue) between the requested Transfer Length and the actual transfer length. It will not be possible to continue the Read operation.

When a variable length block has been truncated due to an Illegal Termination error, Illegal Length is not signaled. Instead the Illegal Termination error takes priority and the Error Code is set to READ RETRIES EXHAUSTED.

17.3.9. Read After Write

If a READ command is issued when the Drive is in WRITE mode (i.e. immediately after a write operation, see section 4.5. Command Sequencing for details), the Drive will terminate the READ command immediately with CHECK CONDITION status. The Error Code is set to either END-OF-DATA DETECTED or END-OF-DATA DETECTED AFTER LEW depending on whether the tape is positioned before or after LEW. The Drive continues to be in WRITE mode.

17.4. Phase Sequencing

In this section the possible SCSI-bus phase sequences during execution of the command are described. Section 3.2.1 has more details about the generic phases in the brackets.

<sequence 1> := <initiator-part> <message-out> <command> <disconnect> <reconnect> <completed>

This sequence will be used when an error is detected during the initial part of the READ command or when the Transfer Length is zero.

<sequence 2> := <initiator-part> <message-out> <command> {<disconnect> <reconnect> <data-in>} <completed>

This sequence will be used when the READ command terminates with GOOD STATUS.

The Drive will first disconnect when the CDB has been transferred. The Drive will reconnect when the number of bytes ready for transfer is equal or larger than the Read Buffer Full Ratio. The Drive will disconnect to make sure that the burst size never exceeds the number of bytes specified by the Maximum Burst Size. The Drive will not disconnect after the last data burst.

<sequence 3> := <initiator-part> <message-out> <command>{<disconnect> <reconnect> <data-in>}<disconnect> <reconnect> <completed>

This sequence will be used when an error is encountered during the READ operation.

The sequence is equal to <sequence 2> except that the Drive will disconnect before sending status.

<sequence 4> := <initiator-part> <message-out> <command> {<data-in>} <completed>

This sequence will be used when the READ command is executed and the Initiator does not allow disconnection.

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18. Read Block Limits

18.1. Command Description

The READ BLOCK LIMITS command requests the Drive's capability for block length limits to be returned. The READ BLOCK LIMITS Parameter List will be returned during the DATA-IN phase of the command.

18.2. Command Descriptor Block

BYTE	BIT 7	6	5	4	3	2	1	0
00	Operation Code **05h**							
01	Logical Unit Number (LUN)			RESERVED				
02	RESERVED							
03	RESERVED							
04	RESERVED							
05	Control Byte							

Table 18-1: READ BLOCK LIMITS Command Descriptor Block

18.3. Parameter List

BYTE	BIT 7	6	5	4	3	2	1	0
00	RESERVED			Granularity				
01 02 03	Maximum Block Length							
04 05	Minimum Block Length							

Table 18-2: READ BLOCK LIMITS Data

Granularity

The Granularity field has a value of 0 (zero) to indicate that the Drive supports all block sizes that is a multiple of 2^0 (i.e. 1, 2, 3, 4 ... Maximum Block Length)[1].

Maximum Block Length

This field shows the maximum length of a variable length block. The maximum length supported is 262144 (040000h) bytes.

Minimum Block Length

This field shows the minimum length of a variable block. The minimum length supported is 1 byte.

[1] Blocks written using the FIX bit set to one in the WRITE command descriptor block must be even in size (i.e. a size that is a multiple of 2^1).

18.4. Exception Handling

See sections on *Error Conditions For All Commands* and *Deferred Errors*.

18.5. Phase Sequencing

In this section the possible SCSI-bus phase sequences during execution of the command are described. Section 3.2.1 has more details about the generic phases in the brackets.

<sequence 1> := <initiator-part> <message-out> <command> <disconnect> <reconnect> <data-in> <completed>

The Drive will disconnect when the CDB has been transferred. The Drive will reconnect and then transfer the parameter list.

<sequence 2> := <initiator-part> <message-out> <command> <completed>

This sequence will be used when the command is executed and the Initiator does not allow disconnection.

19. Read Buffer

19.1. Command Description

The READ BUFFER command is mainly used in conjunction with the WRITE BUFFER command as a diagnostic function for testing the Drive's data buffer and the SCSI-bus integrity.

The READ BUFFER command may also be used for debugging by transferring debugging data to the initiator.

This command will not alter the status of a possibly inserted tape cartridge in any way.

The READ BUFFER parameter list will be returned during the DATA- IN phase of the command. When transferring data, the total data transfer will be split into smaller bursts with a maximum size. The maximum burst size (the maximum amount of data transferred between reconnects/disconnects) is controlled by the Maximum Burst Size parameter set up by the MODE SELECT command.

If disconnection is allowed, the Drive disconnects when executing this command.

19.2. Command Descriptor Block

BYTE	BIT 7	6	5	4	3	2	1	0
00	Operation Code **3Ch**							
01	Logical Unit Number (LUN)			RESERVED		Mode		
02	Buffer ID							
03 04 05	Buffer Offset							
06 07 08	Allocation Length							
09	Control Byte							

Table 19-1: READ BUFFER Command Descriptor Block

Mode

This field controls the function of the READ BUFFER command. It also controls the meaning of the other fields within this command descriptor block. The following modes are supported:

Mode	Description
2	Read Data
3	Read Descriptor

Table 19-2: Read Buffer Modes

Buffer ID

This field is used to select one out of several buffers in the Drive. The following Buffer IDs are supported:

Buffer ID	Description
0	Data Buffer
1	Static RAM
2	Media Statistics
3	Microcode Store
4	EEPROM
5	External RAM adapter
6	NVP Data
7	Tape Buffer Control Data
8	Volume Directory
9	Dbase Variables
10	Header File Dates
11	Trace Buffer Control Blocks
12	Complete Trace

Table 19-3: Read Buffer ID's

Buffer Offset

The Buffer Offset field specifies an offset into the buffer given by the Buffer ID field. The Buffer Offset is always a *byte* offset into the buffer. If the Buffer Offset is set to *N*, then the first data byte transferred by the READ BUFFER command will be byte *N* relative to the first available byte of the specified buffer. The offset must be less than the size of the buffer specified by the Buffer ID field.

The Buffer Offset field can only be used in mode 2 (Read Data) and when **Buffer ID 2** - Media Statistics is **NOT** selected. The Buffer Offset field is reserved in other modes.

Allocation Length

This field specifies the maximum number of bytes that the Drive is requested to return during the DATA IN phase of the command. If the Allocation Length is zero, the Drive will return no data. The Drive terminates the DATA IN phase when Allocation Length bytes have been transferred or when all the available data from the buffer has been transferred to the Initiator, whichever is less.

19.3. Read Data Mode (2)

In this mode, the DATA-IN phase contains data only (no header). The Buffer ID field identifies a specific buffer within the Drive from which data will be transferred.

19.3.1. Data Buffer (Buffer ID = 0)

The READ BUFFER command will transfer data from the Drive's data buffer. Note that this is the buffer that is normally used to store data going to or coming from the media.

19.3.2. Static RAM (Buffer ID = 1)

The READ BUFFER command will transfer the contents of its Static RAM.

19.3.3. Media Statistics (Buffer ID = 2)

The READ BUFFER command will transfer the media statistics. Since this buffer works as a FIFO the transferred data are consumed, i.e. removed from the FIFO. When Media Statistics Buffer Id is selected the Buffer Offset must be zero.

The number of data to be transferred is the minimum of Allocation length in the CDB for the READ BUFFER command and the available media statistics in 8 byte’s chunks. (Thus the Allocation length in CDB should be a multiple of 8.) If the Buffer Capacity (retrieved by a READ BUFFER command in Descriptor Mode for the Buffer Id 2) is zero, no media statistics are available.

19.3.4. Microcode Store (Buffer ID = 3)

The READ BUFFER command will regenerate and transfer data from its microcode store in a loadable format. It means in a format suitable for upload with the WRITE BUFFER command. See the WRITE BUFFER command for details.

19.3.5. EEPROM (Buffer ID = 4)

The READ BUFFER command will transfer the contents of its EEPROM.

19.3.6. External RAM Adapter (Buffer ID = 5)

If there is an external RAM adapted, the READ BUFFER command will transfer the contents of this external RAM. Otherwise no data is transferred.

19.3.7. NVP DATA (Buffer ID = 6)

The READ BUFFER command will transfer the contents of the NVP (Non Volatile Parameters) area of the Flash PROM.

19.3.8. Tape Buffer Control Data (Buffer ID = 7)

The READ BUFFER command will transfer the contents of the Tape Buffer Control area in DRAM.

19.3.9. Volume Directory (Buffer ID = 8)

The READ BUFFER command will transfer the contents of the Volume Directory area from DRAM.

19.3.10. Dbase Variables (Buffer ID = 9)

The READ BUFFER command will transfer the contents of the Dbase Variable area.

19.3.11. Header File Dates (Buffer ID = 10)

The READ BUFFER command transfers the dates of the header files for the actual code.

19.3.12. Trace Buffer Control Blocks (Buffer ID = 11)

The READ BUFFER command transfers the control blocks for the trace buffer.

19.3.13. Complete Trace Buffer (Buffer ID = 12)

The READ BUFFER command transfers the memory and trace data.

19.4. Read Descriptor Mode (3)

In this mode, a maximum of four bytes of READ BUFFER descriptor information is returned. The Drive will return the descriptor information for the buffer specified by the Buffer ID (see the description of the Buffer ID in Section 19.3). The Drive will return all zeros in the READ BUFFER descriptor if there is no buffer associated with the specified Buffer ID. The Buffer Offset field is reserved in this mode. The Allocation Length should be set to four or greater. The Drive will transfer the lesser of the Allocation Length or four bytes of READ BUFFER descriptor.

BYTE	BIT 7	6	5	4	3	2	1	0
00	Offset Boundary							
01 02 03	Buffer Capacity							

Table 19-4: READ BUFFER Descriptor List

Offset Boundary

There are two possible values for the Offset Boundary; 0h and FFh. When the Offset Boundary field is zero the buffer offset in the READ BUFFER command descriptor block can be on any byte boundary.

When the Offset Boundary field is FFh the buffer offset in the READ BUFFER command descriptor block is not applicable and must be 0. (This occurs only when Buffer Id 2 - Media Statistic is selected.)

Buffer Capacity

The value in the Buffer Capacity field depends on the Buffer ID:

Buffer ID	Associated Buffer	Buffer Capacity (bytes)
0	Data Buffer	max 1507328 / 8126464[1]
1	Static RAM	65536 / 131072[1]
2	Media Statistics	variable, 0 – 16384 / 49152[1]
3	Microcode Store	max 1048752
4	EEPROM	2048
5	External RAM adapter	max 1048576
6	NVP Data	8186 / 73728[2] / 139264[3]
7	Tape Buffer Control Data	max 16384 / 249856[1]
8	Volume Directory	26624
9	Dbase Variables	61440
10	Header File Dates	2048
11	Trace Buffer Control Blocks	6
12	Complete Trace	max 600000

Table 19-5: Buffer Capacity

The Buffer Capacity for Media Statistics tells how much logging information that is available. It may be different for each time the READ BUFFER command is executed.

19.5. Exception Handling

See sections on *Error Conditions For All Commands*, *Deferred Errors* and *Buffer Parity Errors*.

If the Mode is not in the set of legal modes, the Drive will terminate the command with CHECK CONDITION. No data will be transferred. The Drive Error Code will be set to INVALID FIELD IN CDB.

In mode 2 (Read Data), if the value in the Buffer ID field is not in the range of legal values or the Buffer Offset is not less than the size of the specified buffer or the Buffer Offset is not zero when Buffer Id 2 is selected, the Drive will terminate the command with CHECK CONDITION. No data will be transferred. The Drive Error Code will be set to INVALID FIELD IN CDB.

In mode 3 (Read Descriptor), if the Buffer Offset field is not set to zero, the Drive will terminate the command with CHECK CONDITION. No data will be transferred. The Drive Error Code will be set to INVALID FIELD IN CDB.

[1] SLR140, SLR100, SLR75, SLR60, SLR7
[2] SLR7
[3] SLR140, SLR100, SLR75, SLR60

19.6. Phase Sequencing

In this section the possible SCSI-bus phase sequences during execution of the command are described. Section 3.2.1 has more details about the generic phases in the brackets.

<sequence 1> := <initiator-part> <message-out> <command> <disconnect> <reconnect> <completed>

This sequence will be used for a READ BUFFER command specifying a zero transfer length.

<sequence 2> := <initiator-part> <message-out> <command> <disconnect> {<reconnect><data-in> <disconnect>} <reconnect> <completed>

This sequence will be used for the READ BUFFER with transfer length greater than 0.

<sequence 3> := <initiator-part> <message-out> <command> <completed>

This sequence will be used for a READ BUFFER command specifying a zero transfer length when disconnection is not allowed.

<sequence 4> := <initiator-part> <message-out> <command> <data-in> <completed>

This sequence will be used for the READ BUFFER with transfer length greater than 0 and disconnection is not allowed.

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20. Read Position

20.1. Command Description

The READ POSITION command requests the Drive to return a special position key that identifies the current position in the data stream on the medium. While writing (or reading), the READ POSITION command is typically executed every time the medium is at a position that the host system might want to go back to at a later time. The returned position key can then be stored and used as an input to the LOCATE command later. The LOCATE command will then bring the medium back to the same position as it was when the READ POSITION command was executed.

The READ POSITION command requests the Drive to return the block address associated with the current position. The value indicates the block address of the next data block to be transferred between the initiator and the target if a READ or WRITE command is issued.

The READ POSITION command may request this block address to be the *logical* position or the *physical* position.

For SLRtape140 to SLRtape7 or SLR32 media the READ POSITION command supports logical tape positions only. For other medium types both physical and logical positions are supported.

If the READ POSITION command is requested to return block positions as physical tape block addresses, it may give different physical position keys for reading, spacing or writing to the same position on the tape. The READ POSITION physical command can therefore not be used to determine whether a certain position is reached. It will also not be generally possible to calculate (mathematically) the block address of any other position relative to the current position.

If the READ POSITION command returns block positions as physical tape block addresses, two logical blocks might have the same physical address on SLR5 and DC9250 media and the current block size is 512 bytes. The reason is that the READ POSITION command will - if necessary - pad the last half of a QIC-2GB-DC or QIC-4GB-DC (1024 bytes long) physical tape block during WRITE and move the tape position to the start of the next physical tape block before returning any block positions in order to be able to assign unique addresses to all logical blocks.

Note that when using the READ POSITION command to return physical block positions on tapes with compressed data, multiple positions may also yield the same physical block address.

When using a SLRtape140 to SLRtape7 or SLR32 medium tapemarks on the tape count as one logical block each. When using other medium types, tapemarks are not counted as logical blocks.

The Drive will disconnect when executing the READ POSITION command.

20.2. Command Descriptor Block

BYTE	BIT 7	6	5	4	3	2	1	0
00	Operation Code **34h**							
01	Logical Unit Number (LUN)			RESERVED		TCLP	LONG	BT
02	RESERVED							
03	RESERVED							
04	RESERVED							
05	RESERVED							
06	RESERVED							
07	RESERVED							
08	RESERVED							
09	Control Byte							

Table 20-1: READ POSITION Command Descriptor Block

TCLP The Total Current Logical Position (TCLP) bit must be set to zero.

LONG The Long Format bit must be set to zero.

BT The Block Address Type (BT) bit controls the content of the data returned.

When the BT is set to zero, the block locations returned gives the total number of *logical blocks and tapemarks* from the beginning of the partition to the current position.

When the BT bit is set to one, the block locations returned gives the total number of *physical blocks* (including tapemarks, filler blocks etc.) from the beginning of the partition to the current position.

When using a SLRtape140 to SLRtape7 or SLR32 medium the BT bit must be set to zero.

On the SLR140, SLR100, SLR75, SLR60 and SLR7 drives the BT bit must always be set to zero.

20.3. Data Format

BYTE	BIT 7	6	5	4	3	2	1	0
00	BOP	EOP	BCU	BYCU	R	BPU	PERR	R
01	Partition Number							
02	RESERVED							
03	RESERVED							
04 | 07	First Block Location							
08 | 11	Last Block Location							
12	RESERVED							
13 | 15	Number of Blocks in Buffer							
16 | 19	Number of Bytes in Buffer							

Table 20-2: READ POSITION Data

BOP A beginning of partition (BOP) bit indicates that the current tape position is at the beginning-of-partition. A possible read command will read the very first block on the current partition. A possible write command will start writing the very first block on the current partition.

EOP An end of partition (EOP) bit of one indicates that the current logical tape position is located between the Logical Early Warning (LEW) tape marker and the end-of-partition (see also the sections on the READ and WRITE commands)

BCU The block count unknown (BCU) bit is always set to one to indicate that the Number of Blocks in Buffer field does not represent the actual number of blocks in the buffer.

BYCU The byte count unknown (BYCU) bit is always set to one to indicate that the Number of Bytes in Buffer field does not represent the actual number of bytes in the buffer.

BPU

The block position unknown (BPU) bit is set when the block position is not known and cannot be obtained without tape motion. The remainder of the data in the parameter list will not be valid. The block position may be unknown when using mediums without any recorded tape map information. On SLR5 and DC9520 type media tape map information is optional (it may or may not exist on a given tape). Tape map information is always present on SLRtape140 to SLRtape7 or SLR32 media. Note however that the Drive will generate its own tape map information when given the opportunity (when moving sequentially from BOP to EOP on each partition). When using LOCATE physical or SPACE to EOD, the Drive will not be able to generate complete tape map information and the BPU-bit will most likely be set in the parameter list of a subsequent READ POSITION command.

While the Drive is processing an immediate command, the BPU bit will be set to one.

PERR

The Position Error (PERR) bit will be zero to indicate that there is no overflow in any of the returned position data fields.

Partition Number

The partition number indicates the current partition number.

First Block Location

The first block location field indicates the position of the next data block to be transferred between the Initiator and the Drive's data buffer if the previous command was a READ, VERIFY[1] or WRITE command. When the medium is positioned at BOP, the value returned will be 0.

Last Block Location

The last block location field will always be set to zero.

Number of Blocks in Buffer

The number of blocks in buffer field will always be set to zero.

Number of Bytes in Buffer

The number of bytes in buffer field will always be set to zero.

20.4. Exception Handling

See sections on *Error Conditions For All Commands* and *Deferred Errors*.

If the TCLP and LONG bits are not set to zero the command will be terminated with CHECK CONDITION status. The error code will be set to INVALID FIELD IN CDB.

If the BT bit is set to one when using a SLRtape140 to SLRtape7 or SLR32, medium, the READ POSITION command will be terminated with CHECK CONDITION status. No parameter date will be transferred. The Error Code will be set to Invalid field in CDB.

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[1] VERIFY is not supported by SLR7 and SLR140

20.5. Phase Sequencing

In this section the possible SCSI-bus phase sequences during execution of the command are described. Section 3.2 has more details about the generic phases in the brackets.

<sequence 1> := <initiator-part> <message-out> <command> <disconnect> <reconnect> <data-in> <completed>

The Drive will disconnect when the CDB has been transferred. The Drive will reconnect to transfer the parameter data.

<sequence 2> := <initiator-part> <message-out> <command> <completed>

This sequence will be used when the command is executed and the Initiator does not allow disconnection.

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21. Receive Diagnostic Results

21.1. Command Description

The RECEIVE DIAGNOSTIC RESULTS command requests analysis data produced by the last SEND DIAGNOSTICS command to be transferred to the Initiator.

The RECEIVE DIAGNOSTIC RESULTS command must be issued immediately following a SEND DIAGNOSTICS command to ensure valid returned data. To ensure that diagnostic results is not corrupted by a command sent from another initiator, either the SEND DIAGNOSTICS command should be linked to the RECEIVE DIAGNOSTIC RESULTS command or the drive should be reserved. If no Send Diagnostic command has been issued, then the data is specific to the last run selftest (power-on, diagnostic cartridge or self-exerciser selftests).

The analysis data returned by the RECEIVE DIAGNOSTIC RESULTS command has several fields marked “ FOR INTERNAL USE” . These fields hold information of interest for service personnel only.

Note that the RECEIVE DIAGNOSTIC RESULTS command can also be used to get the results from the last completed Stand Alone Diagnostics (SAD) test. The results from the Stand Alone Diagnostic survives Reset/Power On.

21.2. Command Descriptor Block

BYTE	BIT 7	6	5	4	3	2	1	0
00	Operation Code **1Ch**							
01	Logical Unit Number (LUN)			RESERVED				PCV
02	Page Code							
03 04	Allocation Length							
05	Control Byte							

Table 21-1: RECEIVE DIAGNOSTIC RESULTS Command Block

PCV

When the Page Code Valid (PCV) bit is set to one, the Page Code can be set to 00h or 98h.

When the Page Code Valid (PCV) bit is set to zero, the Page Code must be set to 00h. (The most recent SEND DIAGNOSTICS command defines the data returned by this command).

Page Code

The following Page Codes are available:

00h: The analysis data returned will be from the last SEND DIAGNOSTICS command.

98h: The analysis data returned will be from the last completed Stand Alone Diagnostics test. The results from the Stand Alone Diagnostic survives Reset/Power On.
Note that this Page Code is only valid when the PCV bit is set to one.

Allocation Length

This field specifies the length in bytes allocated by the initiator for receipt of the analysis data. For each page returned, the allocation length is the page length plus 4 bytes. The number of data bytes returned by the drive might be less then allocation length, depending on the number of diagnostic tests that has failed. The Drive terminates the DATA-IN phase when Allocation Length bytes have been transferred or when all available analysis data have been transferred, whichever is less. An Allocation Length of zero indicates no analysis data will be transferred.

21.3. Results From the SEND DIAGNOSTICS Command

When the Page Code is set to 00h, the analysis data returned will be from the last SEND DIAGNOSTICS command.

The analysis data returned by the RECEIVE DIAGNOSTIC RESULTS command consists of one or more *pages*. The first (and maybe the only) page is a *header page*. The header page may be followed by zero or more *diagnostic pages*. The number of diagnostic pages available depends on the number of sub-tests that has failed when the diagnostic activity consisted of a predefined sequence of selftests.

When a diagnostic activity has ended without any error the header page will be the only page returned. In this case the header page holds information that indicates that the diagnostic activity did not detect any problems.

When a diagnostic activity has detected one or more errors the header page is followed by one or more diagnostic pages. The header page will in this case hold a diagnosis of the error detected. The diagnostic page(s) themselves then follow the header page.

21.3.1. The Header Page

BYTE	BIT 7	6	5	4	3	2	1	0
00	Page Code							
01	RESERVED							
02 03	Page Length							
04	RESERVED							
05	Sense Key							
06	Additional Sense Code							
07	Additional Sense Code Qualifier							
08	ERAC							
09	FOR INTERNAL USE							
10 11	Number of Result Bytes							
12 | 14	FOR INTERNAL USE							

Table 21-2: The Header Page

Page Code

This field indicates the page code for the last run diagnostic activity. The page code will be in the range 90h to 99h. For a list of supported page codes see section *21.3.3. Supported Page Codes*. The page code of a Header Page is determined by how the diagnostic activity was initiated.

Page Length This field specifies the length in bytes of the analysis data that follow this field. When no errors have been detected there will be no Test Specific Information and the Page Length field will have a value of 11.

Sense Key This field holds information on the cause of error. Refer to the section on General Exception Handling and the REQUEST SENSE command for details.

Additional Sense Code This field holds additional error information. Refer to the section on General Exception Handling and the REQUEST SENSE command for details.

Additional Sense Code Qualifier This field holds additional error information. Refer to the section on General Exception Handling and the REQUEST SENSE command for details.

ERAC This field indicates a suggested action to be taken by the host system or operator when a failure has been signaled by the drive. Refer to the section on General Exception Handling and the REQUEST SENSE command for details.

FOR INTERNAL USE This field is for Tandberg Data internal use only.

Number of Result Bytes This field holds the total number of result bytes transferred to the initiator.

21.3.2. The Diagnostic Pages

All Diagnostic Pages have the same format. Only the length of the Test Specific Information field varies.

BYTE	BIT 7	6	5	4	3	2	1	0
00	Page Code							
01	RESERVED							
02 03	Page Length							
04	RESERVED							
05	Sense Key							
06	Additional Sense Code							
07	Additional Sense Code Qualifier							
08	ERAC							
09	FOR INTERNAL USE							
10 n	Test Specific Info							

Table 21-3: The Diagnostic Pages

Page Code This field indicates the page code for sub-test that failed. The page code will be in the range A0h to DCh. Pages with these page codes are for internal use only.

Page Length This field specifies the length in bytes of the analysis data that follow this field. The Page Length will be equal to the length of the Test Specific Information field plus 6.

Sense Key

This field holds information on the cause of error. Refer to the section on General Exception Handling and the REQUEST SENSE command for details.

Additional Sense Code

This field holds additional error information. Refer to the section on General Exception Handling and the REQUEST SENSE command for details.

Additional Sense Code Qualifier

This field holds additional error information. Refer to the section on General Exception Handling and the REQUEST SENSE command for details.

ERAC

This field indicates a suggested action to be taken by the host system or operator when a failure has been signaled by the drive. Refer to the section on General Exception Handling and the REQUEST SENSE command for details.

FOR INTERNAL USE

This field is for Tandberg Data internal use only.

Test Specific Info

Internal analysis results. TD use only.

21.3.3. Supported Page Codes

Page Code	Predefined Selftest sequences
90h	Header Page for SEND DIAGNOSTICS Selftest 1
91h	Header Page for SEND DIAGNOSTICS Selftest 1 and 2
92h	Header Page for SEND DIAGNOSTICS Selftest 2
93h	RESERVED
94h	Header Page for User Specified Diagnostic Tests
95h	Header Page for Power On Selftest
96h	Header Page for Self-exerciser Selftest
97h	Header Page for Diagnostic Tape
98h	RESERVED
99h	RESERVED
A0h - DCh	FOR INTERNAL USE

Table 21-4: Supported Page Codes

21.4. Results From the Stand Alone Diagnostics Test

When the Page Code is set to 98h, the analysis data returned will be from the last completed Stand Alone Diagnostics test.
The results from the Stand Alone Diagnostic survives Reset/Power On. See the Reference Manual for details about the Stand Alone Diagnostic test.

21.4.1. The Stand Alone Diagnostic Result Page

BYTE	BIT 7	6	5	4	3	2	1	0
00	Page Code							
01	RESERVED							
02 03	Page Length							
04	First failing AID no.							
05	Result from the last SAD							
06	Tape format							
07	RESERVED							
08 09 10 11	Time Stamp for last completed SAD							
12 13 14 15	Current Time Stamp							

Table 21-5: The Stand Alone Diagnostic Page

Page Code

This field is always set to 98h.

Page Length

This field specifies the length in bytes of the analysis data that follow this field. The Page Length will have a value of 12.

First failing AID no.

If the last completed Stand Alone Diagnostics test has failed, this field will be set to the first failing Activity Id (AID) number.

If the last Stand Alone Diagnostics test has been successfully completed, this field will be set to FFh.

Result from the last SAD

This field is set to the test result for the last completed Stand Alone Diagnostics test. This field can have the following values:

00h: Stand Alone Diagnostics test successfully completed.

01h: Stand Alone Diagnostics test has failed.

Tape format

This field is set to the tape format in the last completed Stand Alone Diagnostics test.

Time Stamp for last completed SAD

This Time Stamp is the Power On Time in Minutes in the drive when the last Stand Alone Diagnostics Test was completed.

Current Time Stamp

The Power On Time in Minutes when the RECEIVE DIAGNOSTICS command was issued.

21.5. Exception Handling

See sections on *Error Conditions For All Commands*, *Deferred Errors* and *Buffer Parity Errors*.

21.6. Phase Sequencing

In this section the possible SCSI-bus phase sequences during execution of the command are described. Section 3.2 has more details about the generic phases in the brackets.

<sequence 1>

:= <initiator-part> <message-out> <command> <disconnect> <reconnect> <completed>

The Drive will disconnect when the CDB has been transferred. The Drive will reconnect before transferring the result data.

<sequence 2>

:= <initiator-part> <message-out> <command> <completed>

This sequence will be used when the command is executed and the Initiator does not allow disconnection.

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22. Release

22.1. Command Description

The RELEASE command will release the Drive if it is currently reserved by the requesting Initiator.

It is not an error to attempt to release the Drive if it is not currently reserved by the requesting Initiator. However, the Drive will not be released if it is reserved by another Initiator (the RELEASE command will just be ignored).

The third-party release option allows an Initiator to release the Drive if it was previously reserved using the third-party reservation option (see RESERVE Section). This option is intended for use in multiple-initiator systems.

If disconnection is allowed, the Drive will disconnect.

22.2. Command Descriptor Block

BYTE	BIT 7	6	5	4	3	2	1	0
00	Operation Code **17h**							
01	Logical Unit Number (LUN)			3RD	3RD Party ID			Extent
02	Reservation Identification							
03	RESERVED							
04	RESERVED							
05	Control Byte							

Table 22-1: RELEASE Command Descriptor Block

3RD If the third-party (3RD) bit is zero, then the third-party release option is not requested. If the 3RD bit is one the host wishes to release a reservation it has made for a third-party host.

3RD Party ID This field specifies the ID of the third-party device. This field will be ignored if the 3RD bit is not set to one.

Extent The Extent bit must be set to zero (extent release is not supported).

Reservation Identification The Reservation Identification field must be set to zero.

22.3. Exception Handling

See sections on *Error Conditions For All Commands* and *Deferred Errors.*

If the third party (3RD) bit is one, the third party ID (3RD Party ID) is equal to the Drive's ID and the Drive has been reserved by the requesting Initiator, the RELEASE command will be terminated with CHECK CONDITION status. The Error Code will be set to INVALID FIELD IN CDB.

If the third party (3RD) bit is one, the third party ID (3RD Party ID) is equal to the Drive's ID and the Drive has been reserved by another Initiator, the RELEASE command will be ignored.

22.4. Phase Sequencing

In this section the possible SCSI-bus phase sequences during execution of the command are described. Section 3.2.1 has more details about the generic phases in the brackets.

<sequence 1> := <initiator-part> <message-out> <command> <disconnect> <reconnect> <completed>

The Drive will disconnect when the CDB has been transferred. It then reconnects to transfer status.

<sequence 2> := <initiator-part> <message-out> <command> <completed>

This sequence will be used when the command is executed and the Initiator does not allow disconnection.

23. Request Sense

23.1. Command Description

The REQUEST SENSE command requests that the Drive transfer sense data to the Initiator.

The sense data will be valid for a CHECK CONDITION returned on the prior command. This sense data will be preserved by the Drive for the Initiator until retrieved by the REQUEST SENSE command or until the receipt of any other command from the Initiator that issued the command resulting in the CHECK CONDITION status.

The REQUEST SENSE command will execute even if the Initiator specifies an unsupported LUN (LUN field in the Command Descriptor Block or IDENTIFY message is not set to zero). In this situation other pending sense data will be cleared and the transferred Parameter List will reflect the Unsupported LUN condition.

The REQUEST SENSE command will execute normally even if a reservation conflict exists.

The Drive will never disconnect for this command.

23.2. Command Descriptor Block

BYTE	BIT 7	6	5	4	3	2	1	0
00	Operation Code **03h**							
01	Logical Unit Number (LUN)			RESERVED				
02	RESERVED							
03	RESERVED							
04	Allocation Length							
05	Control Byte							

Table 23-1: REQUEST SENSE Command Descriptor Block

Allocation Length This field specifies the maximum number of bytes allocated by the Initiator for sense data. If the Allocation Length is zero, the Drive will not return any sense data. For any other Allocation Length value, the Drive terminates the DATA-IN phase when Allocation Length bytes have been transferred or when all available sense data have been transferred to the Initiator, whichever is less.

23.3. Parameter List

BYTE	BIT 7	6	5	4	3	2	1	0
00	VADD	Response Code						
01	RESERVED							
02	FMK	EOM	ILI	RES	Sense Key			
03 04 05 06	Information Bytes							
07	Additional Sense Length							
08 09 10 11	RESERVED							
12	Additional Sense Code							
13	Additional Sense Code Qualifier							
14	FRU Code							
15	SKSV	Sense Key Specific						
16 17	Sense Key Specific							
18	RESERVED							
19	Error Recovery Action Code (ERAC)							
20	FOR INTERNAL USE							
21	RESERVED							

Table 23-2: REQUEST SENSE Parameter List

VADD A Valid Address (VADD) bit of zero indicates that the Information Bytes are undefined. A VADD bit of one indicates that the Information Bytes contain valid information.

Response Code The Response Code field is set to 70h for normal errors and to 71h for deferred errors.

FMK The Filemark (FMK) bit indicates that the current command has read a filemark.

EOM The End Of Media (EOM) bit indicates that the last command encountered end-of-partition or beginning-of-partition.

ILI The Incorrect Length Indicator (ILI) bit indicates that the requested logical block length did not match the logical block length found on the tape.

Sense Key This field holds information about the cause of error. See section 23.4. for a description of the Sense Key codes.

Information Bytes

The contents of the Information Bytes is command specific and is defined within the appropriate chapter for the command of interest. Unless otherwise specified, this field contains the difference (residue) of the requested length minus the actual length in either bytes or blocks, as determined by the command. Negative values are indicated by two's complement notation.

Additional Sense Length

This field specifies the number of additional sense bytes to follow. The Additional Sense Length is set to 14.

If the Allocation Length of the Command Descriptor Block is too small to transfer all the additional sense bytes, the Additional Sense Length will not be adjusted to reflect the truncation.

Additional Sense Code

This field holds additional error information. See Section 23.5. and the section on *General Exception Handling*.

Additional Sense Code Qualifier

This field holds additional error information. See also Section 23.5. and the section on *General Exception Handling*.

FRU Code

The Field Replaceable Unit (FRU) Code is set to zero (no FRU information is available).

SKSV

A Sense Key Specific Valid bit of one indicates that the Sense Key Specific field is valid. A SKSV bit of zero indicates that the Sense Key Specific field is not valid.

Sense Key Specific

When the Error Code is INVALID FIELD IN CDB or INVALID FIELD IN PARAMETER LIST, this field tells which bit in the Command Descriptor Block that was invalid and caused the CHECK CONDITION status. The format is shown in the table below:

BYTE	BIT 7	6	5	4	3	2	1	0
15	SKSV	C/D	RESERVED		BPV	Bit Pointer		
16	Field Pointer							
17								

Table 23-3: Sense Key Specific Information, Invalid Fields

C/D

A Command/Data bit of one indicates that the illegal parameter is in the Command Descriptor Block. A C/D bit of zero indicates that the illegal parameter is in the data parameters sent by the Initiator during the DATA OUT phase.

BPV

A Bit Pointer Valid bit of zero indicates that the Bit Pointer field is not valid. A BPV bit of one indicates that the Bit Pointer field is valid.

Bit Pointer The Bit Pointer field specifies the erroneous bit in the byte designated by the Field Pointer. When a multiple-bit field is faulty, the Bit Pointer field will point to the most significant (leftmost) bit of the field.

Field Pointer The Field Pointer field indicates the erroneous byte of the Command Descriptor Block or of the Parameter Block. Bytes are numbered starting from zero.

Error Recovery Action Code

This field indicates a suggested action to be taken by the host system or operator when an exception has been signaled by the drive.

0 : No action
1 : Clean drive
2 : Try another cartridge
3 : Run diagnostics
4 : Re-issue command
5 : Re-issue corrected command and/or parameter list
6 : Call service

FOR INTERNAL USE

This field is for Tandberg Data internal use only.

23.4. Sense Keys

Code	Name	Description
0h	NO SENSE	Indicates that there is no specific sense key information to be reported. This would be the case for a successful command or a command that received a CHECK CONDITION status because one of the FMK, EOM or ILI bits is set to one.
1h	RECOVERED ERROR	Indicates that the last command completed successfully with some recovery action performed by the drive. Used to signal conditions like head cleaning requested and Threshold Condition met.
2h	NOT READY	Indicates that the Drive medium cannot be accessed. This will be the case if there is no cartridge inserted or if it is unloaded, and a media access command is issued.
3h	MEDIUM ERROR	Indicates that the command terminated with an unrecoverable read, write or positioning error
4h	HARDWARE ERROR	The Drive has detected a parity error or some fatal error in the Drive hardware.
5h	ILLEGAL REQUEST	Indicates that there was an illegal parameter in the Command Descriptor Block or in the additional parameters supplied as data for some commands.
6h	UNIT ATTENTION	Indicates that a cartridge has been inserted or that the Drive has been reset since the last command. The condition is cleared for the next command from the same Initiator (see section *3.4 Unit Attention* for details).
7h	DATA PROTECT	Indicates that a write operation has been attempted on write protected cartridge.
8h	BLANK CHECK	Indicates that a LOCATE, SPACE, READ or VERIFY[1] operation encountered erased tape (end of the recorded area).
Bh	ABORTED COMMAND	Indicates that the Drive aborted the command. The Initiator may be able to recover by trying the command again.
Dh	VOLUME OVERFLOW	This condition occurs if additional data blocks are appended after the Drive has reported EOM, and there is not sufficient space left on the tape (see also the WRITE and WRITE FILEMARK Sections).
Eh	MISCOMPARE	Indicates that the source data did not match the data read from the tape during execution of the VERIFY[1] command.

Table 23-4: Sense Keys

[1] VERIFY is not supported by SLR7 and SLR140

23.5. Additional Sense Code and Qualifier

Error code table sorted by AS/AQ code.
The same table sorted by name is located in Section 7.1.

AS	AQ	SK	FMK	EOM	ILI	ERAC	Name
00h	00h	0h			■	5	NO ADDITIONAL SENSE INFORMATION, ILLEGAL LENGTH BLOCK READ
00h	01h	0h	■			5	FILEMARK DETECTED
00h	02h	3h		■		5	END-OF-PARTITION/MEDIUM DETECTED ON READ, PHYSICAL END REACHED
00h	02h	0h		■		0	END-OF-PARTITION/MEDIUM DETECTED ON WRITE, LEW PASSED
00h	02h	Dh		■		0	END-OF-PARTITION/MEDIUM DETECTED ON WRITE, PHYSICAL END REACHED
00h	03h	0h	■			5	SETMARK DETECTED
00h	04h	0h		■		5	BEGINNING-OF-PARTITION/MEDIUM DETECTED
00h	05h	8h				5	END-OF-DATA DETECTED
00h	05h	8h		■		5	END-OF-DATA DETECTED AFTER LEW
00h	17h	1h				1	CLEANING REQUESTED
03h	02h	3h				2	EXCESSIVE WRITE ERRORS (SERVO)
03h	02h	3h				1	EXCESSIVE WRITE ERRORS
04h	00h	2h				5	LOGICAL UNIT NOT READY, CAUSE NOT REPORTABLE
04h	01h	2h				4	LOGICAL UNIT IS IN THE PROCESS OF BECOMMING READY
04h	02h	2h				5	LOGICAL UNIT NOT READY, INITIALIZING COMMAND REQUIRED
09h	00h	3h				2	TRACK FOLLOWING ERROR
09h	01h	4h				6	TRACKING SERVO FAILURE
0Ch	05h	1h				5	DATA EXPANSION OCCURRED DURING COMPRESSION
11h	00h	3h				1	UNRECOVERED READ ERROR
11h	01h	3h				1	READ RETRIES EXHAUSTED
11h	0Dh	3h				5	DECOMPRESSION CRC ERROR
11h	0Eh	3h				5	CANNOT DECOMPRESS USING THE DECLARED ALGORITHM
14h	00h	8h				5	RECORDED ENTITY NOT FOUND
15h	01h	3h				2	MECHANICAL POSITIONING ERROR, ILLEGAL HEAD POSITION
1Ah	00h	5h				5	PARAMETER LIST LENGTH ERROR
1Dh	00h	Eh				0	MISCOMPARE DURING VERIFY OPERATION
20h	00h	5h				5	INVALID COMMAND OPERATION CODE
24h	00h	5h				5	INVALID FIELD IN CDB
25h	00h	5h				5	LOGICAL UNIT NOT SUPPORTED
26h	00h	5h				5	INVALID FIELD IN PARAMETER LIST
27h	00h	7h				4	WRITE PROTECTED
27h	05h	7h				2	PERMANENT WRITE PROTECTED (CARTRIDGE END OF LIFE)

Table 23-5: Additional Sense Code and Qualifier (to be continued…)

AS	AQ	SK	FMK	EOM	ILI	ERAC	Name
28h	00h	6h				4	NOT READY TO READY TRANSITION, MEDIUM MAY HAVE CHANGED
29h	00h	6h				4	POWER ON / RESET OCCURRED
2Ah	01h	6h				4	MODE PARAMETERS CHANGED
2Ah	02h	6h				4	LOG PARAMETERS CHANGED
2Ch	00h	5h				5	COMMAND SEQUENCE ERROR
30h	00h	5h				2	INCOMPATIBLE MEDIUM INSTALLED
30h	01h	3h				2	CANNOT READ MEDIUM - UNKNOWN FORMAT
30h	02h	3h				2	CANNOT READ MEDIUM, INCOMPATIBLE FORMAT
30h	03h	2h				2	CLEANING CARTRIDGE INSTALLED
30h	06h	5h				2	CANNOT FORMAT MEDIUM, INCOMPATIBLE MEDIUM
30h	07h	3h				2	CLEANING FAILURE
3Ah	00h	2h				2	MEDIUM NOT PRESENT
3Dh	00h	5h				5	INVALID BITS IN IDENTIFY MESSAGE
3Fh	01h	6h				4	MICROCODE HAS BEEN CHANGED
40h	80h	4h				3	DIAGNOSTIC FAILURE, BUFFER PARITY ERROR
40h	81h	4h				6	DIAGNOSTIC FAILURE, WRITE CHIP ERROR
40h	A0h	4h				6	DIAGNOSTIC FAILURE, MULTIPLE ERRORS
40h	nnh[1]	4h				6	DIAGNOSTIC FAILURE IN SELFTEST N[2]
43h	00h	5h				5	MESSAGE ERROR
44h	00h	4h				6	INTERNAL TARGET FAILURE
47h	00h	Bh				4	SCSI PARITY ERROR
48h	00h	Bh				5	INITIATOR DETECTED ERROR MESSAGE RECEIVED
4Eh	00h	Bh				5	OVERLAPPED COMMANDS ATTEMPTED
50h	00h	5h				5	WRITE APPEND ERROR
50h	01h	3h				1	WRITE APPEND POSITION ERROR
51h	00h	3h				3	ERASE FAILURE
52h	00h	3h				2	CARTRIDGE FAULT, BAD CARTRIDGE
52h	00h	3h				1	CARTRIDGE FAULT, REFERENCE BURST SEEK FAILURE
53h	00h	Bh				2	MEDIA LOAD OR EJECT FAILED
53h	02h	2h				5	MEDIUM REMOVAL PREVENTED
5Bh	01h	6h				4	THRESHOLD CONDITION MET
5Bh	02h	1h				4	LOG COUNTER AT MAXIMUM
82h	83h	6h				4	CLEANING CARTRIDGE EJECTED

Table 23-5: Additional Sense Code and Qualifier

[1] nn is a hex number in the range A1h to C8h inclusive. A1h corresponds to a diagnostic failure in selftest 1, A2h corresponds to a diagnostic failure in selftest 2 and so on up to C8h which corresponds to a diagnostic failure in selftest 40.

[2] N is a number in the range 1 to 40 inclusive.

23.6. Exception Handling

The REQUEST SENSE command will return the CHECK CONDITION status only to report fatal errors for the REQUEST SENSE command. Fatal errors are: non-zero bit in command descriptor or parity error on the data bus.

23.7. Phase Sequencing

In this section the possible SCSI-bus phase sequences during execution of the command are described. Section 3.2 has more details about the generic phases in the brackets.

<sequence 1> := <initiator-part> <message-out> <command> <data-in> <completed>

The Drive will never disconnect when executing this command.

24. Reserve

24.1. Command Description

The RESERVE command will reserve the Drive exclusively for the requesting Initiator or another specified SCSI device.

The reservation will remain in effect until superseded by another RESERVE command from the Initiator that made the reservation or until released by a RELEASE command from the same Initiator, or a BUS DEVICE RESET message from any Initiator, or a SCSI-bus reset condition. It will not be an error to issue this command to the Drive if it is currently reserved to the requesting Initiator.

If the Drive is previously reserved by another Initiator, then the Drive will return RESERVATION CONFLICT status.

If, after honoring the reservation, any other Initiator subsequently attempts to perform any command except INQUIRY, REQUEST SENSE, PREVENT ALLOW MEDIUM REMOVAL (with a prevent bit of zero) or RELEASE, the command will be rejected with RESERVATION CONFLICT status. A RELEASE command issued by another Initiator will be ignored by the reserved Drive.

The third-party reservation option allows an Initiator to reserve the Drive for another SCSI device. This option is intended for use in multiple-initiator systems that use the COPY command.

If the third-party reservation option is used (by setting the 3RD bit), then the RESERVE command will reserve the Drive for the SCSI device specified in the third-party device ID field (3RD Party ID). The Drive will preserve the reservation until superseded by another RESERVE command from the Initiator that made the reservation or until released by the same Initiator, by a BUS DEVICE RESET message from any Initiator, or by a SCSI-bus reset condition. The Drive will ignore (i.e., return GOOD status) any attempt made by any other Initiator to release the reservation.

An Initiator that holds a current reservation may modify that reservation (e.g., switch third-parties) by issuing another RESERVE command to the Drive. The superseding RESERVE command will release the previous reservation state only when the new reservation is granted.

If disconnection is allowed, the Drive will only disconnect when executing this command if the previous command was an immediate type command.

24.2. Command Descriptor Block

BYTE	BIT 7	6	5	4	3	2	1	0
00	Operation Code **16h**							
01	Logical Unit Number (LUN)			3RD	3RD Party ID			Extent
02	Reservation Identification							
03	RESERVED							
04	RESERVED							
05	Control Byte							

Table 24-1: RESERVE Command Descriptor Block

3RD If the third-party (3RD) bit is zero, the third-party reservation option is not requested. If the 3RD bit is one, the Drive will be reserved for the SCSI device specified in the third-party device ID field (3RD Party ID).

3RD Party ID This field specifies the ID of the third-party device.

Extent The Extent bit must be set to zero (extent reservation is not supported).

Reservation Identification The Reservation Identification field must be set to zero.

24.3. Exception Handling

See sections on *Error Conditions For All Commands* and *Deferred Errors*.

If the third party (3RD) bit is one and the third party ID (3RD Party ID) is equal to the Drive's ID, the RESERVE command will be terminated with CHECK CONDITION status. The Error Code will be set to INVALID FIELD IN CDB.

24.4. Phase Sequencing

In this section the possible SCSI-bus phase sequences during execution of the command are described. Section 3.2.1 has more details about the generic phases in the brackets.

<sequence 1> := <initiator-part> <message-out> <command> <disconnect> <reconnect> <completed>

The Drive will disconnect when the CDB has been transferred. The Drive will reconnect and then transfer status.

<sequence 2> := <initiator-part> <message-out> <command> <completed>

This sequence will be used when the command is executed and the Initiator does not allow disconnection.

25. Rewind

25.1. Command Description

The REWIND command requests the Drive to rewind the tape to the beginning of the current partition.

Prior to the execution of the rewind operation, the Drive will write any buffered data that is to be written to the tape. If however, the previous command was terminated with CHECK CONDITION and the Drive is in buffered mode, then the Drive will discard any buffered data when a REWIND command has been validated. When using SLRtape140 to SLRtape7 or SLR32 media, the media header is updated when the tape has been rewound to BOT.

If disconnection is allowed, the Drive will disconnect when executing this command.

25.2. Command Descriptor Block

BYTE	BIT 7	6	5	4	3	2	1	0
00	Operation Code **01h**							
01	Logical Unit Number (LUN)			RESERVED				IMM
02	RESERVED							
03	RESERVED							
04	RESERVED							
05	Control Byte							

Table 25-1: REWIND Command Descriptor Block

IMM

An Immediate (IMM) bit of zero indicates that the Drive will not return status until the rewind operation has completed. An IMM bit of one indicates that the Drive will return status as soon as the execution of all previous commands have been completed and the Command Descriptor Block of the REWIND command has been validated. If CHECK CONDITION status is returned for the REWIND command with an IMM bit of one, the rewind operation will not be performed.

25.3. Exception Handling

See sections on *Error Conditions For All Commands*, *Deferred Errors* and *Error Conditions For Media Access Commands*.

If the IMM and Link bits are both set to one, the Drive will terminate the REWIND command with CHECK CONDITION status. The Error Code will be set to INVALID FIELD IN CDB.

25.4. Phase Sequencing

In this section the possible SCSI-bus phase sequences during execution of the command are described. Section 3.2.1 has more details about the generic phases in the brackets.

<sequence 1> := <initiator-part> <message-out> <command> <disconnect> <reconnect> <completed>

This sequence will be used for all REWIND commands when disconnection is allowed.

<sequence 2> := <initiator-part> <message-out> <command> <completed>

This sequence will be used when the ERASE command is executed and the Initiator does not allow disconnection.

26. Send Diagnostics

26.1. Command Description

The SEND DIAGNOSTICS command requests the Drive to perform diagnostic tests on itself.

A possible SEND DIAGNOSTICS parameter list is transferred during the DATA OUT phase of the command.

Before starting the actual tests the SEND DIAGNOSTIC command will write any buffered data in the Drive's data buffer to the tape. When a Predefined Selftest Sequence 1 has completed successfully, a loaded medium will be rewound back to the beginning of the current partition. When a Predefined Selftest Sequence 2 has completed successfully, the medium will be positioned at BOP_0 (the beginning of partition 0).

When a diagnostic test has executed successfully, the SEND DIAGNOSTICS command will return GOOD status. When a diagnostic test has failed, the SEND DIAGNOSTICS command will return CHECK CONDITION status. The REQUEST SENSE command can then be used to get further information on the error. In addition the RECEIVE DIAGNOSTIC RESULTS command can be used to requests detailed test result data produced by the last SEND DIAGNOSTICS command to be transferred to the Initiator.

26.2. Command Descriptor Block

BYTE	BIT 7	6	5	4	3	2	1	0
00	Operation Code **1Dh**							
01	Logical Unit Number (LUN)			PF	R	ST	DOF	UOF
02	RESERVED							
03 04	Parameter List Length							
05	Control Byte							

Table 26-1: SEND DIAGNOSTIC Command Descriptor Block

PF The Page Format (PF) bit MUST be set zero.

ST A self-test bit of one indicates the device will perform its default self-test A Self-Test bit of zero is reserved for Internal Use only.

DOF A Device Off-line bit of one indicates the device can only perform tests that do NOT affect user media(Predefined self-test list 1).

UOF A Unit Off-line bit of one indicates the device will perform all tests, which include cartridge manipulation, reading and writing to test media (Predefined self-test list 2).

Parameter List Length

This field specifies the length in bytes of the parameter list that will be transferred from the Initiator to the Drive. A Parameter List Length of zero indicates that no data will be transferred. The Parameter List Length should be set to zero. Parameter List Length greater than zero is reserved for Internal Use only.

The following table shows the legal settings and the corresponding actions taken for the ST (SelfTest), DOF (DevOfl) and UOF (UnitOfl) bits:

ST	DOF	UOF	Diagnostic Action
0	0	0	For Internal Use only
0	0	1	Illegal combination
0	1	0	Illegal combination
0	1	1	Illegal combination
1	0	0	Predefined Selftest Sequence 1 (not affecting media)
1	0	1	Predefined Selftest Sequence 2 (affecting media)
1	1	0	Predefined Selftest Sequence 1 (not affecting media)
1	1	1	Predefined Selftest Sequences 1 and 2

Table 26-2: SEND DIAGNOSTICS Functions

26.3. Predefined Selftest Sequence 1

Selftest sequence 1 does not affect media (other than writing out buffered data remaining in the Drive’s data buffer when the test is started). The following tests are performed:

- **FLASH Memory Check.** This is a test of the Flash PROM integrity calculating a simple 32-bit sum of the whole Flash area.
- **SRAM Test.** Complete Address test of the whole SRAM Area.
- **EEPROM Recognize Test.** Read Test of known values. Write/Read test of dedicated Test Cells.
- **Data Path Controller (DPC) Test.** The followings modules will be tested:
  - **1)** Register Test.
  - **2)** Test of the DPC 8 Bit and 16 bits RAM's.
  - **3)** Memory (DRAM) Access Channels module (MAC).
  - **4)** Error Correction Channel module (ECC).
  - **5)** Physical Data Formatter module (PDF).
  - **6)** Test the of Arbitration between all data channels accessing the data buffer
  - **7)** Interrupt Logic test.
- **DRAM Test.** The DRAM is tested using the DPC Fill & Verify module.
- Data Compression Controller Test.
  - **1)** Register test.
  - **2)** Compression/Decompression test with different data patterns.
- **Servo Control Test.** Calibration test. DSP self-test. Address-test of the DSP RAM. Synthetic test of the Voice Coil Driver and feedback loop.
- Analog Data Path (ADP) Test.
  - **1)** Recognize test of all ASIC’s involved.
  - **2)** If a cartridge is not inserted; complete read/write data path loop-back test without preamplifier.
- Micro Controller Test.

26.4. Predefined Selftest Sequence 2

Selftest sequence 2 will affect (write over) the currently inserted media. Previously written data will be lost. In addition, the test will partition the tape to a single partition. The following tests are performed:

- **Cartridge Manipulation Functional Test.** Load/unload cartridge and measure time of operation and motor current during operation. The test focus is on motor/mechanical problems forcing operation out of specification.

- **Read/Write Test.** Real read and write using tape. The test focus is on Drive HW problems.

This test involves actual reading and writing on the tape. Note that the tape is always rewound back to BOT before Selftest Sequence 2 is started. The tape format actually used will be set automatically to the highest format allowed on the inserted medium type.

The data pattern alternates between four different patterns: a block count pattern, a 29h pattern, a 60h pattern and a byte count pattern.

After the write test the tape is rewound to BOT. A read test is performed. Here the data is read back from the tape in streaming mode.

During the tests no “hard” errors are normally allowed. If a “hard” read or write error or more rereads than specified should occur, the test will be aborted. The SEND DIAGNOSTICS command returns with CHECK CONDITION status. If no “hard” read or write error has occurred and the rereads are within the specified limit, no error is reported when the test completes.

26.5. Exception Handling

See sections on *Error Conditions For All Commands*, *Deferred Errors* and *Buffer Parity Errors*.

If the PF bit is not set to zero, the Drive will terminate the SEND DIAGNOSTICS command with CHECK CONDITION status. No diagnostic tests will be performed. The Error Code will be set to INVALID FIELD IN CDB.

If the ST, DOF and UOF bits are not within the legal values, the Drive will terminate the SEND DIAGNOSTICS command with CHECK CONDITION status. No diagnostic tests will be performed. Error Code will be set to INVALID FIELD IN CDB.

If ST bit is set to one and parameter list length is not zero, the Drive will terminate the SEND DIAGNOSTICS command with CHECK CONDITION status. No diagnostic tests will be performed. The Error Code will be set to INVALID FIELD IN CDB.

If the Parameter List Length is not within the legal value, the SEND DIAGNOSTICS command will be terminated with CHECK CONDITION status. No diagnostic tests will be performed. The Error Code will be set to INVALID FIELD IN CDB.

If the Parameter List has any illegal values, the SEND DIAGNOSTICS command will be terminated with CHECK CONDITION status. No diagnostic tests will be performed. The Error Code will be set to INVALID FIELD IN PARAMETER LIST.

If DOF bit is set to one but the media is not present, the SEND DIAGNOSTICS command will be terminated with CHECK CONDITION status. No diagnostic tests will be performed. The Error Code will be set to MEDIUM NOT PRESENT.

26.6. Phase Sequencing

In this section the possible SCSI-bus phase sequences during execution of the command are described. Section 3.2.1 has more details about the generic phases in the brackets.

<sequence 1> := <initiator-part> <message-out> <command> <disconnect> <reconnect> <completed>

The Drive will disconnect when the CDB has been transferred. The Drive will reconnect when all the diagnostic activities are executed.

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27. Space

27.1. Command Description

The SPACE command provides a variety of positioning functions determined by a space code and a space count. Both forward (toward end-of-media) and reverse (toward beginning-of-media) positioning are provided.

The SPACE command allows the Initiator to space over blocks, tapemarks (filemarks or setmarks), sequential tapemarks, bad blocks or to End-Of-Data (EOD).

When spacing over blocks or tapemarks, the count specifies the number of blocks or tapemarks to be spaced over. When spacing N blocks or tapemarks in the forward direction, the space will end on the end-of-media side of the last block or tapemark spaced. When spacing N blocks or tapemarks in the reverse direction the space will end on the beginning-of-media side of the last block or tapemark spaced.

When spacing over N sequential tapemarks, the count specifies that the space will end at the first occurrence of N or more consecutive tapemarks. The tape will be logically positioned at the end-of-media side (forward space) or at the beginning-of-media side (reverse space) of the n'th tapemark.

Reverse space over sequential tapemarks is recommended **not** to be used. The operation is time consuming and causes a lot of shuffles on the tape.

When spacing to End-Of-Data (EOD) the Count field will be ignored. This space function is always using the “fast seek” algorithm. After a successful space to EOD, a subsequent WRITE (or WRITE FILEMARKS) command will append data to the last recorded block.

When spacing over bad blocks the Drive will space over an area of contiguous unreadable tape. The Count field and the FAST bit are ignored for this operation. When the space over bad block operation is executed, the Drive will space over all bad blocks until the next good logical block is found. If there are no bad blocks in the buffer, the data position is unchanged.

The SPACE command is able to space over blocks written in both fixed and variable length modes. The SPACE command is able to automatically determine the block type while spacing.

If disconnection is allowed, the Drive will disconnect when executing this command.

27.2. Command Descriptor Block

BYTE	BIT 7	6	5	4	3	2	1	0
00	Operation Code **11h**							
01	Logical Unit Number (LUN)			RESERVED		Code		
02 03 04	Count							
05	FAST	X	RESERVED				Flag	Link

Table 27-1: SPACE Command Descriptor Block

Code

The Space Code is defined as follows:

0 : Space over Blocks
1 : Space over Filemarks
2 : Space over Sequential Filemarks
3 : Space to End-Of-Data (EOD)
4 : Space over Setmarks
5 : Space over Sequential Setmarks
7 : Space over Bad Blocks

Count

This field specifies the number if blocks to space (Code=0), the number of filemarks to space (Code=1 or Code=2) or the number of setmarks to space (Code=4 or Code=5). The Count field is ignored when spacing to End-Of-Data (Code=3) and when spacing over bad blocks (Code=7). A positive Count field will cause forward positioning. A negative Count field (2's complement notation) will cause reverse positioning. A zero value in the Count field will cause no tape movement (except for Code=3 and Code=7). This is not an error condition.

FAST

When the FAST bit is set to zero, the Drive will execute the SPACE command in a standard sequential fashion. All data between the current position and the terminal position are check-read by the Drive.

When the FAST bit is set to one the Drive will use a special fast space algorithm. When using this algorithm, the Drive is not able to test for possible bad/corrupted data blocks on the tape. See the next section for details.

When spacing in the reverse direction, the Drive will, if possible, use the fast space algorithm, even if the FAST bit is set to zero.

Note that the FAST bit may be overridden by the FAST bit in the Miscellaneous Page of the MODE SELECT parameter data.

27.3. Using Fast Space

The FAST option enables the Drive to perform fast space to any data or tapemark block on the tape. All SPACE operations except Space over Sequential Filemarks and Space over Sequential Setmarks will use the FAST algorithm if the command is issued with the FAST bit set. For Space over Sequential Filemarks the FAST bit is ignored. Instead of searching in serpentine mode through every track set, the Drive will use information recorded on the tape to move directly to the wanted position. When this option is used, the Drive will still be able to report detected tapemarks during the space blocks operation. Unrecoverable blocks between the start and end position will, however, most likely not be detected.

Using the FAST option, all spaces will normally be significantly faster than if NORMAL SPACE is chosen. The only case when FAST SPACE can be more time consuming is the first time when a SPACE command is issued into an area of the tape that has not been read or written since insertion of the cartridge, and where the end position is relatively close to the start position (on the *same track set).*

Instead of selecting FAST or normal space operation on a command to command basis, it is possible to have the Drive always use the FAST space algorithm by means of an option controlled by the MODE SELECT command. By doing so, the system drivers will not have to be changed to get the advantage of FAST spaces. See the *Miscellaneous Parameters Page* of the MODE SELECT command for details.

The recorded help information needed to enable FAST space operations is transparent to the user and it does not violate any of the tape standards.

27.4. Exception Handling

27.4.1. General

See sections on *Error Conditions For All Commands*, *Deferred Errors* and *Error Conditions For Media Access Commands*.

When the SPACE command has started execution, all detected errors will set the VADD bit and the Information Bytes will hold the difference between the requested and the actual number of blocks/tapemarks spaced. Note, however, that when spacing sequential tapemarks, the VADD bit is never set and the Information Bytes are never valid. See the following sections for details.

A CHECK CONDITION caused by early termination of any SPACE command never results in a negative Information Bytes (residual count) value.

27.4.2. No Data

If the drive is not able to find data on the inserted cartridge the SPACE command will be terminated with CHECK CONDITION. The error code will be set to END-OF-DATA DETECTED or RECORDED ENTITY NOT FOUND.

A SPACE to End-Of-Data will terminate with GOOD STATUS when no data can be found.

A SPACE to End-Of-Data on an erased SLR5 or DC9250 medium results however in CHECK CONDITION. The error code will be set to RECORDED ENTITY NOT FOUND with Sense Key for Blank Check.

When spacing over blocks or tapemarks the valid (VADD) bit in the sense data list will be set to one. The Information Bytes will be set equal to the requested Count value.

When spacing over sequential tapemarks the VADD bit will be set to zero.

27.4.3. Filemark Detected

If a filemark is encountered while spacing over blocks, the SPACE command will be terminated with CHECK CONDITION status. The Error Code will be set to FILEMARK DETECTED. The Information Bytes in the sense data will be set to the difference (residue) of the requested count minus the actual number of blocks spaced over (not including the filemark). The logical position will be on the end-of-partition (EOP) side of the filemark if movement was in the forward direction or the beginning-of-partition (BOP) side of the filemark if movement was in the reverse direction.

27.4.4. Setmark Detected

If a setmark is encountered while spacing over blocks or filemarks, the SPACE command will be terminated with CHECK CONDITION status. The Error Code will be set to SETMARK DETECTED. The Information Bytes in the sense data will be set to the difference (residue) of the requested count minus the actual number of blocks spaced over (not including the setmark). The logical position will be on the end-of-partition (EOP) side of the setmark if movement was in the forward direction or the beginning-of-partition (BOP) side of the setmark if movement was in the reverse direction.

27.4.5. End of Data

If end-of-data (EOD) is encountered while spacing forward over blocks, tapemarks or sequential tapemarks, the Drive will return CHECK CONDITION status. The Error Code will be set to END-OF-DATA DETECTED and the Sense Key will be set to BLANK CHECK. Additionally the EOM bit will be set to one if the end of data was encountered at or after the physical early warning (EW) tape marker on the last track set. If end of data is encountered before the early warning marker, the EOM bit will be set to zero. When spacing over blocks or tapemarks the Valid (VADD) bit will be set to one and the Information Bytes in the sense data will be set to the difference (residue) of the requested count minus the actual number of blocks and tapemarks. When spacing over sequential tapemarks the VADD bit will be set to zero. The logical tape position will be so that a subsequent WRITE or WRITE FILEMARK command will append data to the last recorded block.

27.4.6. Beginning of Partition

If the beginning of partition is encountered while spacing in the reverse direction, the Drive will return CHECK CONDITION status. The Error Code will be set to BEGINNING-OF-PARTITION/MEDIUM DETACHED. Additionally, when spacing over blocks or tapemarks, the Drive will set the end-of-media (EOM) and Valid (VADD) bits to one. The Information Bytes in the sense data will be set to the difference (residue) of the requested count minus the actual number of blocks and tapemarks spaced over. When spacing over sequential tapemarks the VADD bit will be set to zero. The logical tape position will be so that a subsequent read operation will read the first block on the tape.

27.4.7. End of Partition

If end of partition is encountered while spacing in the forward direction, the Drive will return CHECK CONDITION status. The Error Code will be set to END-OF-PARTITION/MEDIUM DETECTED ON READ, PHYSICAL END REACHED and the Sense Key will be set to MEDIUM ERROR. When spacing over blocks or tapemarks the Valid (VADD) bit will be set to one and the Information Bytes in the sense data will be set to the difference (residue) of the requested count minus the actual number of blocks and tapemarks spaced over. When spacing over sequential tapemarks the VADD bit will be set to zero. The logical tape position will be undefined and all new READ, SEEK BLOCK and SPACE commands will be terminated immediately with CHECK CONDITION status as if they just ran into the end of partition. A WRITE or WRITE FILEMARKS command will also be terminated immediately with CHECK CONDITION status. The Error Code will then be set to WRITE APPEND ERROR. A position type command (ERASE, LOAD/UNLOAD or REWIND) must be executed before subsequent read or write operations can be started.

27.4.8. Non-Recoverable Read Error During Space Forward

If a non-recoverable read error occurs during the execution of a SPACE FORWARD command, the bad block will be assumed to be a data block and the Drive will terminate the SPACE command with CHECK CONDITION status. The Error Code will be set to READ RETRIES EXHAUSTED. When spacing over blocks or tapemarks the valid (VADD) bit in the sense data list will be set to one. The Information Bytes will be set to the difference (residue) between the requested count and the actual number of blocks or filemarks and setmarks spaced over (the bad block will count as one spaced block). When spacing over sequential tapemarks the VADD bit will be set to zero. When the command has terminated, the logical tape positions will be after the bad physical tape block.

When READ RETRIES EXHAUSTED has been reported the Drive will only accept the following media access commands:

- LOAD and REWIND
- SPACE with a space code of *Space Over Bad Blocks*.
- READ

When the Drive receives a new READ command the Drive will execute a Space Over Bad Blocks operation to move the logical tape position until it can safely detect the beginning of a logical block. This READ command will not transfer any data and it will be terminated with another CHECK CONDITION status (indicating READ RETRIES EXHAUSTED). Yet another READ command will start transferring data from this logical block.

If there are more non-recoverable errors in the next logical block also, good data is again transferred up to the first error, CHECK CONDITION is reported and the whole process described above is repeated.

27.4.9. Error Condition or Bad Block During Space Reverse

If a bad block or an error condition is detected during Space Reverse (blocks, tapemarks or sequential tapemarks), the command terminates with CHECK CONDITION status. The Error Code will be set to READ RETRIES EXHAUSTED. When spacing over blocks or tapemarks the VADD bit is set in the Sense Data and the Information Bytes will hold the residual count. In this case the error or bad block may have been detected logically *in front of* the destination position.

This can happen as the Drive is not able to actually read in reverse direction. It therefore has to fill the buffer with data and then test the buffer in reverse direction. The buffer will then typically also contain blocks that are logically in front of the destination position. One of these blocks may be bad and a retry operation may end with an Error Code of READ RETRIES EXHAUSTED.

When spacing over sequential tapemarks the VADD bit will be set to zero.

Further space operations in the reverse direction are not allowed after a non-recoverable read error.

28.4.10. Space Forward After Write

If a SPACE forward command issued when the Drive is in WRITE mode (i.e. immediately after a write operation, see section 4.5. Command Sequencing for details), the Drive terminates the command immediately with CHECK CONDITION status. The Error Code is set to either END-OF-DATA DETECTED or END-OF-DATA DETECTED AFTER LEW depending on whether the tape is positioned before or after LEW. The Drive continues to be in WRITE mode.

If the space operation requested is in the reverse direction however, the Drive enters NAVIGATE mode and the SPACE command is executed.

27.5. Phase Sequencing

In this section the possible SCSI-bus phase sequences during execution of the command are described. Section 3.2.1 has more details about the generic phases in the brackets.

<sequence 1> := <initiator-part> <message-out> <command> <disconnect> <reconnect> <completed>

The Drive will disconnect when the CDB has been transferred. The Drive will reconnect when the space operation has completed (or an error has been detected).

<sequence 2> := <initiator-part> <message-out> <command> <completed>

This sequence will be used when disconnection is not allowed.

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28. Test Unit Ready

28.1. Command Description

The TEST UNIT READY command provides a means to check if the Drive is ready for a medium access command. If the Drive would accept an appropriate medium access command without returning CHECK CONDITION status, this command will return GOOD status. See the section on *Command Set Summary* for the list of Medium Access Commands.

The Drive will not disconnect when executing this command.

28.2. Command Descriptor Block

BYTE	BIT 7	6	5	4	3	2	1	0
00	Operation Code **00h**							
01	Logical Unit Number (LUN)			RESERVED				
02	RESERVED							
03	RESERVED							
04	RESERVED							
05	Control Byte							

Table 28-1: TEST UNIT READY Command Descriptor Block

28.3. Exception Handling

See section *Error Conditions For All Commands*.

In addition the TEST UNIT READY command will respond with CHECK CONDITION status in the following situations:

Sense Key	AS/AQ	Description	Comments
ILLEGAL REQUEST	25h/00h	LOGICAL UNIT NOT SUPPORTED	The LUN field of the IDENTIFY message or in the CDB is not zero.
NOT READY	04h/01h	LOGICAL UNIT IS IN THE PROCESS OF BECOMING READY	The Drive is performing an auto-load or a load operation. This response is produced only when the BSYA bit of the Miscellaneous Parameters Page is set to 1.
NOT READY	04h/02h	LOGICAL UNIT NOT READY, INITIALIZING COMMAND REQUIRED	The medium is inserted, but not loaded. The Initiator should issue a LOAD command.
NOT READY	30h/03h	CLEANING CARTRIDGE INSTALLED	The Drive can not perform media accesses on a cleaning cartridge.
NOT READY	3Ah/00h	MEDIUM NOT PRESENT	There is no medium or the medium has been ejected.

Table 28-2: TEST UNIT READY Response

28.4. Phase Sequencing

In this section the possible SCSI-bus phase sequences during execution of the command are described. Section 3.2.1 has more details about the generic phases in the brackets.

<sequence 1> := <initiator-part> <message-out> <command> <completed>

The Drive will never disconnect when executing this command.

29. Verify (not for SLR7 and SLR140)

29.1. Command Description

The VERIFY command verifies one or more block(s) beginning with the next block on the tape.

The VERIFY command can operate in two different modes indicated by the Byte Compare (CMP) bit. When the CMP bit is set to zero, the verification is simply a medium verification (CRC/ECC check) and no data is transferred from the Initiator to the Drive. When the CMP bit is set to one, the Drive will perform a byte-by-byte compare of the data read from the tape and the data transferred from the Initiator. Data is transferred from the Initiator to the Drive as in a WRITE command.

The Fixed (FIX) bit specifies both the meaning of the Verification Length field and whether fixed-length or variable length block(s) are to be verified.

When the FIX bit is set to zero, the Drive is requested to verify a single variable length data block. The Verification Length specifies the block length in number of bytes. The actual block length is expected to be equal to the specified block length.

When the FIX bit is set to one, the Drive is requested to verify the requested number of fixed length blocks. All the blocks are expected to be of the same length. The length expected is the length reported by the MODE SENSE command (the Block Size field of the Block Descriptor List). Note that a FIX bit of one is not legal when the Drive has been set into Variable Block mode. Variable Block mode is in effect when the Block Size field in the Block Descriptor List of the MODE SELECT command is set to zero (000000h). See the MODE SELECT command for further details.

If the requested Verification Length is zero, the Drive will verify no data and the logical tape position will not be changed. This will not be considered as an error.

If the VERIFY command is the first media access command executed on a newly inserted cartridge, the verify operation will start from BOP. If the VERIFY command follows an ERASE, LOAD/UNLOAD (with Load bit set to one) or REWIND command, the verify operation will also start from BOP. If the VERIFY command follows a READ, LOCATE, SPACE or another VERIFY command, the verify operation will start with the next block on the tape.

Upon termination of a successful VERIFY command, the logical tape position will be after the last block (fixed or variable) verified (end-of-partition side).

In the Drive the actual data compare will be done on the SCSI-bus side of the data buffer. This means that when a VERIFY command terminates, all data transferred have already been verified. This will guarantee that no deferred errors occur due to a miscompare.

If disconnection is allowed, the Drive will disconnect when executing this command.

29.2. Command Descriptor Block

BYTE	BIT 7	6	5	4	3	2	1	0
00	Operation Code **13h**							
01	Logical Unit Number (LUN)			RESERVED		IMM	CMP	FIX
02 03 04	Verification Length							
05	Control Byte							

Table 29-1: VERIFY Command Descriptor Block

IMM

The immediate (IMM) bit is ignored by the Drive.

When byte-by-byte data compare is performed (CMP bit is set to one), the Drive sends status immediately after data transfer. Since the Drive compares data at the SCSI-bus side of the data buffer, the VERIFY command is terminated when status is sent.

When only CRC/ECC check is performed (CMP bit set to zero) the VERIFY command does not return with status until all the requested data has been verified.

CMP

A Byte Compare (CMP) bit of zero indicates that the verification will be simply a CRC/ECC verification. No data will be transferred between the Initiator and the Drive. The VERIFY command will then be functionally equivalent to a SPACE block forward command (without the FAST option).

A CMP bit of one indicates that a byte-by-byte compare of the data on tape and the data transferred from the Initiator will be performed by the Drive. Data will be transferred from the Initiator to the Drive as in a WRITE command.

FIX

A Fixed (FIX) bit of zero indicates that a single block will be verified with the Verification Length specifying the expected length of the block in number of bytes to be verified.

A FIX bit of one indicates that the Verification Length specifies the number of blocks to be verified beginning with the next logical block. Note that a FIX bit of one is not allowed when the Drive is in Variable Block mode (see the *Block Size* field in the Block Descriptor List of the MODE SELECT command for further details).

Verification Length

This field specifies the number of bytes or blocks requested for verification. Any value in the range 0..16777215 is legal. Note, however, that the maximum block size that can be written is 262144 bytes.

29.3. Exception Handling

If a miscompare is detected (CMP bit of one), the VERIFY command will be terminated with CHECK CONDITION status. The Error Code will be set to MISCOMPARE DURING VERIFY OPERATION. The Valid (VADD) bit in the sense data list will be set to one. If the FIX is set to one, the Information Bytes in the sense data will be set to the difference (residue) between the Verification Length and the actual number of blocks successfully transferred. If the FIX bit is set to zero, the Information Bytes in the sense data will be set to the difference (residue) between the Verification Length and the actual number of bytes successfully transferred. When the command has terminated, the tape will be logically positioned after the last block transferred (end-of-partition side).

Note, when a miscompare is detected, the Drive will not terminate the data transfer immediately but complete the current data burst. This means that when a miscompare error has been signaled to the Initiator, the actual byte(s) in error is (are) somewhere in the last transferred burst.

For further exception handling, see the section on *Exception Handling* for the READ command.

29.4. Phase Sequencing

In this section the possible SCSI-bus phase sequences during execution of the command are described. Section 3.2.1 has more details about the generic phases in the brackets.

<sequence 1> := <initiator-part> <message-out> <command> <disconnect> <reconnect> <completed>

This sequence will be used if the CMP bit is zero (no data transfer). The sequence will also be used when an error is detected during the initial part of the VERIFY command or when the Verification Length is zero.

<sequence 2> := <initiator-part> <message-out> <command> {<disconnect> <reconnect> <data-in>} <completed>

This sequence will be used when the VERIFY command with CMP bit set terminates with GOOD STATUS.

The Drive will first disconnect when the CDB has been transferred.

<sequence 3> := <initiator-part> <message-out> <command>{<disconnect> <reconnect> <data-in>}<disconnect> <reconnect> <completed>

This sequence will be used when an error is encountered during the VERIFY operation.

<sequence 4> := <initiator-part> <message-out> <command> {<data-in>} <completed>

This sequence will be used when the VERIFY command is executed and the Initiator does not allow disconnection.

is transferred to the drive.

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30. Write

30.1. Command Description

The WRITE command transfers one or more blocks from the Initiator to the tape at the current tape position.

The Fixed (FIX) bit specifies both the meaning of the Transfer Length field and whether fixed-length or variable length block(s) are to be transferred. The data to be written will be transferred during the data-out phase of the command.

When the FIX bit is set to zero, the Drive is requested to transfer a single variable length data block. The Transfer Length specifies the length of the block in number of bytes.

When the FIX bit is set to one, the Drive is requested to transfer a number of fixed length blocks. The Transfer Length specifies the number of blocks to transfer. All blocks will be of equal length. The length used is the length reported by the MODE SENSE command (the Block Size field of the Block Descriptor List). Note that a FIX bit of one is not legal when the Drive has been set into Variable Block mode. Variable Block mode is in effect when the Block Size field in the Block Descriptor List of the MODE SELECT command is set to zero (000000h). See the MODE SELECT command for further details.

If the requested Transfer Length is zero, the Drive will transfer no data and the logical tape position will not be changed. This will not be considered an error.

Upon termination of a successful WRITE command, the logical tape position will be after the last block (fixed or variable) written (end-of-media side).

The WRITE command can operate in unbuffered and buffered mode. For unbuffered operation, the Drive will not return GOOD status until all data blocks are successfully written to the medium. For buffered operation, the Drive may return GOOD status as soon as all data blocks are successfully transferred to the Drive's data buffer. The data blocks will not be written to the medium before the amount of data in the Drive's data buffer exceeds the Write Buffer Full Ratio (see MODE SELECT command).

When operating in buffered mode; a WRITE FILEMARKS command with the IMM bit set to zero may be issued when completing a WRITE operation to ensure that all the buffered data and the tapemarks are written to the tape.

A write operation may commence from BOP, from EOD or, when certain conditions are satisfied, from other positions on the media.

If disconnection is allowed, the Drive will disconnect when executing this command.

30.2. Command Descriptor Block

BYTE	BIT 7	6	5	4	3	2	1	0
00	Operation Code **0Ah**							
01	Logical Unit Number (LUN)			RESERVED				FIX
02 03 04	Transfer Length							
05	RESERVED						FLAG	LINK

Table 30-1: WRITE Command Descriptor Block

FIX A Fixed (FIX) bit of zero indicates that a single block will be transferred with the Transfer Length specifying the length of the block in bytes. A FIX bit of one indicates that the Transfer Length specifies the number of fixed length blocks to be transferred from the Initiator.

Transfer Length This field specifies the number of bytes or blocks requested for transfer. Any value in the range 0..262144 is legal when the FIX bit is set to zero. When the FIX bit is set to one any value in the range 0..16777215 is legal.

30.3. Data Compression

The Drive is able to compress the data before it is written to the medium. The compression capability is controlled by parameters in the Data Compression Page of the MODE SELECT command. Compression may here be turned on or off.

30.4. Write from BOP

Write from BOP is allowed:

- *when the Write command is the first medium access command executed on a newly inserted cartridge. If the partition number is not explicitly changed, the Drive will start writing on partition zero.*
- *after an ERASE, LOAD (with Load bit set to one) or REWIND command. Refer to the corresponding command description for the partition number.*
- *after a SPACE or LOCATE command which terminated with CHECK CONDITION and Error Code set to BEGINNING-OF-PARTITION/MEDIUM DETECTED.*
- *when the tape is logically positioned at BOP after a successful SPACE or LOCATE command.*

30.5. Write from EOD, Append

If the WRITE command follows a LOCATE, READ, SPACE, VERIFY, WRITE FILEMARKS or another WRITE command, and the tape is positioned for a data append, the write operation will start at the current tape position.

30.6. Writing Over Existing Data, Overwrite

The Drive may in certain cases allow a limited possibility for overwrite. See section *2.5 Overwrite* for details.

30.7. Terminating Write Operations

When writing on a tape, the write operation must be properly terminated before the cartridge is suitable for reading on the same or any other Drive. The cartridge is suitable for reading when all the buffered data (and tapemarks) and an end-of-data marker is written to the tape. If necessary, FILLER blocks are padded to fill up the last frame written. For some medium types (SLRtape140 to SLRtape7 or SLR32) it will also be necessary to update the Media Header information located near the BOM marker on the loaded medium.

The following commands will force all the buffered data (and tapemarks) and the end-of-data marker to be written to the tape:

- LOAD/UNLOAD
- LOCATE
- REWIND
- SPACE
- WRITE FILEMARKS (if IMMEDIATE bit not set)
- WRITE FILEMARKS (if Number of Filemarks is zero)

If the Drive is configured to unbuffered mode, WRITE commands will not terminate before all data transferred from host is written to the tape. This will reduce the performance.

Note:
When the Drive is in unbuffered mode the actual capacity of a tape may be much less than specified if the Transfer Length of the write command is small. This is because FILLER blocks are used to fill the last frame of all WRITE commands.

The following commands will perform a Media Header update:

- LOAD/UNLOAD
- REWIND

The Drive will ensure that a cartridge may not be ejected without terminating the write operation properly. If eject is requested (either by pressing the Eject Button or by issuing an UNLOAD command), the buffered data (and tapemarks) and an end-of-data marker are written to the tape. The tape is then rewound to BOT and the Media Header is updated. Finally the cartridge is physically ejected.

30.8. Exception Handling

30.8.1. General

See sections on *Error Conditions For All Commands*, *Deferred Errors*, *Error Conditions For Media Access Commands* and *Buffer Parity Errors*.

When the WRITE command has started execution, all detected errors will set the VADD bit and the Information Bytes will hold the difference between the requested and the actual transfer length. See the following sections for details.

If the FIX bit is one and the Drive is in Variable Block mode, the WRITE command will be terminated with CHECK CONDITION. The Error Code will be set to INVALID FIELD IN CDB. No data will be transferred.

If the Transfer Length is not in the legal range, the WRITE command will be terminated with CHECK CONDITION. The Error Code will be set to INVALID FIELD IN CDB. No data will be transferred.

If the inserted cartridge is write-protected, the WRITE command will be terminated with CHECK CONDITION status. No data will be transferred. The Error Code will be set to WRITE PROTECTED. This will be true even if the requested Transfer Length is zero.

30.8.2. Unsupported Block Length

If the FIX bit is set to one and the block size configured by the Block Length field of the Block Descriptor List (of the MODE SELECT command) is not in the range of legal values, the WRITE command is terminated with CHECK CONDITION status. The Error Code will be set to INCOMPATIBLE MEDIUM INSTALLED. No data will be transferred. See section *14.3.2 Block Descriptor List* for information on the range of legal block lengths.

30.8.3. Illegal Media Type

When an illegal combination of a medium and a drive is detected, the Drive will terminate the WRITE command with CHECK CONDITION status. The Error Code will be set to INCOMPATIBLE MEDIUM INSTALLED. No data will be transferred.

The following table indicates legal/illegal medium/drive combinations:

Tape Drive / Medium	SLR7	SLR50	SLR60	SLR75	SLR100	SLR140
DC9200		R	R*	R		
DC9200SL		R	R*	R		
DC9250		R	R*	R		
SLR5	R	R	R	R		
SLR5 SL	R	R	R	R		
SLRtape24		**R/W**	R	R	R	
SLRtape24 SL		**R/W**	R	R	R	
MLR1-26GB		**R/W**	R	R	R	
MLR1-26GBSL		**R/W**	R	R	R	
SLR32		**R/W**	R	R	R	
SLR32 SL		**R/W**	R	R	R	
SLRtape7	**R/W**		R	R	R	R
SLRtape7 SL	**R/W**		R	R	R	R
SLRtape40			**R/W**	**R/W**	**R/W**	**R/W**
SLRtape50		**R/W**	**R/W**	**R/W**	**R/W**	**R/W**
SLRtape50 SL		**R/W**	**R/W**	**R/W**	**R/W**	**R/W**
SLRtape60			**R/W**	**R/W**	**R/W**	**RW**
SLRtape75			**R/W**	**R/W**	**R/W**	**R/W**
SLRtape100					**R/W**	**R/W**
SLR40/60/100 - 10GB			**R/W**	**R/W**	**R/W**	**R/W**
SLRtape140						**R/W**

Table 30-2: Legal Media/Drive Combinations

R/W	May read and write
R	May read only
N/A	May not read nor write
	Illegal media/format combination

NOTE *:
On SLR60 tape drives with MAN. DATE 2802 (July 2002) or higher.

30.8.4 Illegal Overwrite

If the current tape position is not at BOP or EOD and overwrite is not in effect (see section 2.5 Overwrite for details), a write operation will be terminated immediately with CHECK CONDITION status and the Error Code is set to WRITE APPEND ERROR (Write After Read). No data will be transferred.

30.8.5. Illegal Append Tape Format

When appending data on a pre-recorded tape, the only legal tape format is the format found on the tape. If the current density is not equal to the tape format, the Drive will ignore the current density and append with the same tape format as found on the tape. If, however, the format on the tape is a Read Only format for that drive (ref. Table 30-2), the WRITE command will be terminated with CHECK CONDITION status. The Error Code will be set to INCOMPATIBLE MEDIUM INSTALLED. No data will be transferred.

30.8.6. Logical Early Warning

If logical early warning (LEW) tape marker is reached during the execution of a WRITE command, the Drive will respond as described below:

- *The Drive will stop transferring data. The Drive will then attempt to write all buffered data (and tapemarks) to the tape. The WRITE command will then be terminated with CHECK CONDITION. If all data in the buffer was successfully written to the tape, the Error Code will be set to END-OF-PARTITION/MEDIUM DETECTED ON WRITE, LEW PASSED and the Sense Key will be set to NO SENSE. The EOM and VADD bits will be set to one.*

  The Information Bytes in the sense data list will be set as follows:

  1) *If the FIX bit is set to one, the Information Bytes will be set to the difference (residue) of the requested Transfer Length minus the actual number of transferred blocks.*

  2) *If the FIX bit is set to zero, the Information Bytes will be set to the difference (residue) of the requested Transfer Length minus the actual number of transferred bytes.*

  The Drive will force unbuffered mode (regardless the state of the BM bit in the MODE SELECT/SENSE Parameter List).

- *If a read type command (READ, LOCATE, SPACE or VERIFY), has brought the tape past the LEW marker and an Append Operation is attempted, then the Drive will terminate the first WRITE command immediately with CHECK CONDITION. No data will be transferred. The Error Code will be set to END-OF-PARTITION/MEDIUM DETECTED ON WRITE, LEW PASSED and the Sense Key will be set to NO SENSE. The EOM and VADD bits will be set to one. The Information Bytes in the sense data list will be set equal to the requested Transfer Length.*

- *If another WRITE command is received by the Drive while the tape is positioned after LEW (but before end of partition), the Drive will transfer and write all requested data if possible. The WRITE command will then be terminated with CHECK CONDITION (this will be true even if the requested Transfer Length was zero). If all data in the buffer was successfully written to the tape the Error Code will be set to END-OF-PARTITION/MEDIUM DETECTED ON WRITE, LEW PASSED and the Sense Key will be set to NO SENSE. The EOM and VADD bits will be set to one. The Information Bytes will be set to zero.*

30.8.7. End of Partition

If end of partition is reached during the execution of a WRITE command, the Drive will terminate the command with CHECK CONDITION status. The Error Code will be set to END-OF-PARTITION/MEDIUM DETECTED ON WRITE, PHYSICAL END REACHED and the Sense Key will be set to VOLUME OVERFLOW. The Valid (VADD) and End Of Media (EOM) bits will be set to one.

The Information Bytes in the sense data list will be set as follows:

1) If the FIX bit is set to one, the Information Bytes will be set to the difference (residue) of the requested Transfer Length minus the actual number of written blocks.

2) If the FIX bit is set to zero, the Information Bytes will be set to the difference (residue) of the requested Transfer Length minus the actual number of written bytes.

This error condition has priority over the Logical Early Warning (LEW) error condition.

Additional WRITE commands issued after an end-of-partition error has occurred will be terminated immediately with a CHECK CONDITION (no data will be transferred). The end-of-partition condition will persist until a position type command has been executed (ERASE, LOAD/UNLOAD or REWIND).

30.8.8. Non-Recoverable Write Error

If a non-recoverable write error occurs, the Drive will terminate the WRITE command with CHECK CONDITION status. The Error Code will be set to EXCESSIVE WRITE ERRORS and the Sense Key will be set to MEDIA ERROR. The Valid (VADD) bit will be set to one.

The Information Bytes in the sense data list will be set as described in Section 31.5.5.

This error condition has priority over the Logical Early Warning error condition.

Additional WRITE commands issued after a non-recoverable write error has occurred, will be terminated immediately with a CHECK CONDITION (no data will be transferred). The non-recoverable write error condition will persist until a position type command has been executed (ERASE, LOAD/UNLOAD or REWIND).

30.8.9. Append Error

If the WRITE command is executed after READ, LOCATE, SPACE or VERIFY command or after a WRITE command where the data in the drive internal buffer has been flushed to the tape, the Drive must seek the last block on the tape before the write operation starts. In all these situations an End Of Data marker will identify where the last block transferred is located on the tape. If this seek operation fails, the Drive will terminate the WRITE command with a CHECK CONDITION status. The Error Code will be set to WRITE APPEND POSITION error and the Sense Key will be set to MEDIA ERROR. The Valid (VADD) bit will be set to one.

The Information Bytes in the sense data list will be set as described in Section 30.5.5.

The EOD marker will reside on the tape, ensuring consecutive read operations to terminate with END OF DATA DETECTED.

The Append Error condition has priority over the Logical Early Warning error condition.

Additional WRITE commands issued after a non-recoverable write error has occurred, will be terminated immediately with a CHECK CONDITION (no data will be transferred). The append error condition will persist until a position type command has been executed (ERASE, LOAD/UNLOAD or REWIND).

30.9. Phase Sequencing

In this section the possible SCSI-bus phase sequences during execution of the WRITE command are described. Section 3.2.1 has more details about the generic phases in the brackets.

<sequence 1> := <initiator-part> <message-out> <command> <disconnect> <reconnect> <completed>

This sequence will be used when an error is detected during the initial part of the WRITE command or when the Transfer Length is zero.

<sequence 2> := <initiator-part> <message-out> <command>{<disconnect> <reconnect> <data-out>}<completed>

This sequence will be used when the Drive is configured to buffered mode and the WRITE command terminates with GOOD STATUS.

The Drive will first disconnect when the CDB has been transferred. The Drive will reconnect when there is room in the data buffer for at least the number of bytes specified by the Write Buffer Empty Ratio. The Drive will disconnect to make sure that the burst size never exceeds the number of bytes specified by the Maximum Burst Size. Note, the Drive will not disconnect after the last data burst.

<sequence 3> := <initiator-part> <message-out> <command>{<disconnect> <reconnect> <data-out>}<disconnect> <reconnect> <completed>

This sequence will be used when the Drive is configured to unbuffered mode or when an error is encountered during the WRITE operation.

The sequence is equal to <sequence 2> except that the Drive will disconnect after the last data burst.

<sequence 4> := <initiator-part> <message-out> <command> <completed>

This sequence will be used when disconnect is not allowed and an error is detected during the initial part of the WRITE command or when the Transfer Length is zero.

<sequence 5> := <initiator-part> <message-out> <command> <data-out> <completed>

This sequence will be used when disconnect is not allowed and some data is transferred to the drive.

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31. *Write Buffer*

31.1. Command Description

The WRITE BUFFER command is used in conjunction with the READ BUFFER command as a diagnostic function for testing the Drive's data buffer and the SCSI-bus integrity. Additional modes are provided for downloading and saving of microcode.

The WRITE BUFFER Parameter List will be transferred during the DATA-OUT phase of the command.

The WRITE BUFFER command will only be accepted when there is no installed cartridge or if an installed cartridge is logically positioned at BOP. This restriction is included to make sure that the WRITE BUFFER command will not alter the status of a possibly inserted cartridge in any way. The Initiator may issue a REWIND command ahead of a WRITE BUFFER command to make sure that the cartridge is logically positioned at BOP.

If disconnection is allowed, the Drive disconnects when executing this command. When transferring data, the total data transfer will be split into smaller bursts with a maximum size. The maximum burst size (the amount of data transferred between reconnects/disconnects) is controlled by the Maximum Burst Size parameter set up by the MODE SELECT command.

31.2. Command Descriptor Block

BYTE	BIT 7	6	5	4	3	2	1	0
00	Operation Code **3Bh**							
01	Logical Unit Number (LUN)			RESERVED		Mode		
02	Buffer ID							
03	Buffer Offset							
04								
05								
06	Parameter List Length							
07								
08								
09	X	X	RESERVED				Flag	Link

Table 31-1: WRITE BUFFER Command Descriptor Block

Mode This field controls the function of the WRITE BUFFER command. It also controls the meaning of the other fields within this command descriptor block. The following modes are supported:

Mode	Description
0	Write Combined Header and Data
2	Write Data
4	Download Microcode
5	Download Microcode and Save Mode
7	Download Microcode with Offsets and Save Mode

Table 31-2: Supported Modes

Buffer ID

This field selects which buffer that receives data. There are 4 legal values:.

00h : Data Buffer
80h : TD Internal Use
81h : TD Internal Use
82h : TD Internal Use

The Buffer ID MUST be set to zero in Modes 0 and 7. The Buffer ID field is ignored in Modes 4 and 5

Buffer Offset

The Buffer Offset specifies a byte offset into the buffer (or microcode load). If the Buffer Offset is set to *N*, then the first data byte transferred by the WRITE BUFFER command will be put into byte *N*, relative to the first byte of the buffer.

The Buffer Offset MUST be zero when Mode 0 is selected.

The Buffer Offset plus Parameter List Length MUST NOT exceeds the capacity of the specified buffer. The capa-city can be determined through READ BUFFER command.

Parameter List Length

The Parameter List Length field specifies the number of bytes that shall be transferred during the DATA-OUT phase. If the Parameter List Length is zero no data will be transferred.

The Buffer Offset plus Parameter List Length MUST NOT exceeds the capacity of the specified buffer (four plus buffer capacity in the case of Mode 0). The capacity can be determined through READ BUFFER command.

Link

The Link-bit must be set to zero in mode 5 and 7 when saving of microcode is going to be performed.

See section *4.2. Command Control Byte* for the use of the Link bit in other modes.

31.3. Write Combined Header and Data Mode (0)

This Mode is included solely for backward compatibility. Data transferred in this mode is preceded by four bytes header. All four bytes of this header are RESERVED.

31.4. Write Data Mode (2)

In this mode, the DATA-OUT phase contains buffer data only. Data is written to the Drive's data buffer starting at the location specified by the Buffer Offset. The Parameter List Length field specifies the number of transferred bytes.

31.5. Download Microcode Mode (4)

In this mode, drive-specific microcode can be transferred to the Drive's data buffer. The microcode change will not take effect until after a WRITE BUFFER with mode 5 (Download Microcode and Save Mode) has been executed. Note that the transferred microcode will be lost after a power-cycle or reset as long as it has not been saved.

Note that the WRITE BUFFER command in this mode does not perform any validation of the transferred microcode data. The validation is performed first when a microcode is going to be saved. Data is written to the Drive's data buffer starting at the location specified by the Buffer Offset.

To ensure that the microcode is not corrupted by another SCSI command, it is recommended that either the WRITE BUFFER commands are linked or that the Drive is reserved by using the RESERVE command.

31.6. Download Microcode and Save Mode (5)

In this mode, drive-specific microcode can be transferred to the Drive data buffer. If the WRITE BUFFER command is completed successfully the microcode will be saved in a non-volatile memory space (a Flash EPROM). The downloaded code will then be effective after each power-cycle and reset until it is supplanted in another Download Microcode and Save Mode or Download Microcode with Offsets and Save Mode operation.

The Initiator may either transfer a complete microcode in one single WRITE BUFFER command (using mode 5 with a Parameter List Length of flash capacity) or to split the download operation into several (smaller) WRITE BUFFER commands (using first mode 4 and then end the sequence with the mode 5). It is up to the Initiator to make sure that the use of the Buffer Offset and Parameter List Length results in a continuous set of microcode data.

On the last WRITE BUFFER command mode 5, the Drive shall perform verification of the complete set of the microcode prior to returning GOOD status and saving the microcode. (refer to the Microcode Verification and Save section later in this chapter).

31.7. Download Microcode with Offsets and Save Mode (7)

In this mode the initiator may split the transfer of microcode over two or more WRITE BUFFER commands. If the last WRITE BUFFER command of a set of one or more commands completes successfully, the microcode shall be saved in a non-volatile memory space (a Flash EPROM). The downloaded code will then be effective after each power-cycle and reset until it is supplanted in another Download Microcode and Save Mode or Download Microcode with Offsets and Save Mode operation.

When the Drive detects the receipt of the last WRITE BUFFER command with mode 7, the Drive shall perform verification of the complete set of the microcode prior to returning GOOD status and saving the microcode. (refer to the Microcode Verification and Save section later in this chapter).

Note that the transferred microcode will be lost after a power-cycle or reset as long as it has not been saved.

To ensure that the microcode is not corrupted by another SCSI command, it is recommended that either the WRITE BUFFER commands are linked or that the Drive is reserved by using the RESERVE command. Note that the last WRITE BUFFER command in Mode 7 must be issued with Link Bit equal 0.

31.8. Microcode Verification and Save

Before saving any microcode the Drive will perform several tests on the microcode data to make sure that the data really are microcode data intended for the Drive.

- The Microcode Version field must match the Drive's version identifier located in the Drive Flash PROM. This prevents the possibility of changing the microcode version of the Drive.
- The Mainboard Revision located in the Microcode Header must be higher or equal the Mainboard Revision in the Mainboard. This prevents the possibility of saving microcode meant for a different hardware.
- The Microcode ECC check must be correct.

If any of these tests fails the WRITE BUFFER command will be terminated with a CHECK CONDITION status. The microcode in the data buffer is not saved and the current microcode is left unchanged.

If the disconnection is allowed, the Drive will disconnect from the SCSI-bus before the save operation. When the save operation has completed successfully, the Drive will reconnect to the Initiator and send GOOD status.

If disconnection is not allowed and the verification of the code was passed through, the drive will give GOOD status *before* the save operation is executed.

While performing the save operation (during Flash PROM programming), the Drive will *not* respond to any SCSI activity except for a hard SCSI reset. A hard SCSI reset will most likely make the save operation fail and the Drive will then need servicing. This is *not* a recommended procedure.

If the save operation fails, the Drive will indicate the error with the front LED as in Selftest (see drive's reference manual for details on the LED [1]). It will not be possible to access the Drive via the SCSI-bus after a save failure. The Drive needs to be serviced since a power-up will not clear this error condition.

After the save operation, the Drive will generate a Unit Attention condition - “ Microcode Has Been Changed” for all Initiators except the Initiator that issued the WRITE BUFFER command. For the Initiator that issued the WRITE BUFFER command the Drive will generate a Unit Attention condition - “ Power-Up/Reset” .

The time required for saving the microcode (Flash PROM programming) are:

Time for saving of the Microcode:

Typical: 45 sec
Maximum: 400 sec

31.9. Microcode Data Format

The microcode consists of a Microcode Header followed by up to 1M bytes of microcode. The last 6 bytes of the microcode are ECC bytes.

Byte	Size	Description
00 - 03	4	Microcode Length
04 - 07	4	Load Length
08 - n	n - 8	Internal Used Field
n+1 - 1048752	up to 1MB	Microcode

Table 31-3: Microcode Data Format.

Microcode Length This 4-byte field holds the length of the microcode including the header.

Load Length Microcode length + header length.

31.10. Exception Handling

See sections on *Error Conditions For All Commands*, *Deferred Errors* and *Buffer Parity Errors*.

If the WRITE BUFFER command is received while the inserted tape is not logically positioned at BOP, the Drive will terminate the WRITE BUFFER with CHECK CONDITION. The Drive Error Code will be set to COMMAND SEQUENCE ERROR. No data will be transferred.

If the Mode is not in the set of legal modes, the Drive will terminate the WRITE BUFFER with CHECK CONDITION. The Drive Error Code will be set to INVALID FIELD IN CDB. No data will be transferred.

If the Parameter List Length plus the Buffer Offset exceeds the capacity of the data buffer, the WRITE BUFFER command will be terminated with a CHECK CONDITION status. The Drive Error Code will be INVALID FIELD IN CDB. No data will be transferred.

If the Buffer ID is not set to zero in mode 0,2 or 7, the Drive will terminate the WRITE BUFFER command with CHECK CONDITION status. The Drive Error Code will be INVALID FIELD IN CDB. No data will be transferred.

If the validity checks made on the microcode data prior saving in mode 5 or 7 fails, the WRITE BUFFER command will be terminated with a CHECK CONDITION status. The Drive Error Code will be INVALID FIELD IN PARAMETER LIST. In this case internal data structures in the drive may have been damaged and the Drive should be reset before any new commands are issued.

If the Link bit is set to one in mode 5 or in the last WRITE BUFFER command in mode 7, the WRITE BUFFER command will be terminated with a CHECK CONDITION status. The Drive Error Code will be INVALID FIELD IN CDB. No data will be transferred.

If a Mode 5 or 7 command is issued while the Drive is in a load/retention sequence, the Drive will return CHECK CONDITION status, and the Error Code will be set to LOGICAL UNIT IS IN THE PROCESS OF BECOMING READY.

31.11. Phase Sequencing

In this section the possible SCSI-bus phase sequences during execution of the command are described. Section 3.2.1 has more details about the generic phases in the brackets.

<sequence 1> := <initiator-part> <message-out> command> <disconnect> <reconnect> <completed>

This sequence will be used when the specified transfer length in the WRITE BUFFER command is zero.

<sequence 2> := <initiator-part> <message-out> <command> <disconnect> {<reconnect> <data-out> <disconnect>} <reconnect> <completed>

This sequence will be used when the transfer length is greater than zero in the WRITE BUFFER command.

The Drive will disconnect when the number of data bytes just transferred equals the number of bytes specified by the Maximum Burst Size field in MODE SELECT command. The Drive will then reconnect immediately to transfer another burst with a maximum size again controlled by the Maximum Burst Size.

<sequence 3> := <initiator-part> <message-out> command> <completed>

This sequence will be used when the specified transfer length in the WRITE BUFFER command is zero and disconnection is not allowed.

<sequence 4> := <initiator-part> <message-out> <command> <data-out> <completed>

This sequence will be used when the transfer length is greater than zero and disconnection is not allowed.

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32. Write Filemarks

32.1. Command Description

The WRITE FILEMARKS command causes the specified number of tapemarks to be written beginning at the current tape position. A zero value of tapemarks indicates that no tapemarks are to be written. This can be used to force any buffered write data or tapemarks to be written to the tape.

If the WRITE FILEMARKS command is the first media access command executed on a newly inserted cartridge, the write operation will start from BOM. If the WRITE FILEMARKS command follows an ERASE, LOAD/UNLOAD (with Load bit set to one) or REWIND command, the write operation will also start from BOM. If the WRITE FILEMARKS command follows a READ, SPACE, WRITE or another WRITE FILEMARKS command, and the tape is in an append position, the write filemark operation will start at the current tape position.

Upon termination of a successful WRITE FILEMARKS command, the logical tape position will be after the last tapemark written (end-of-partition side).

See also the WRITE command for details on terminating write operations.

If disconnection is allowed, the Drive will disconnect when executing this command.

32.2. Command Descriptor Block

BYTE	BIT 7	6	5	4	3	2	1	0
00	Operation Code **10h**							
01	Logical Unit Number (LUN)			RESERVED			WSmk	IMM
02 03 04	Number of Tapemarks							
05	Control Byte							

Table 32-1: WRITE FILEMARKS Command Descriptor Block

WSmk

A Write Setmark (WSmk) bit of one indicates that the Write Filemarks command should write the requested number of *setmarks.* A Write Setmark (WSmk) bit of zero indicates that the Write Filemarks command should write the requested number of *filemarks*.

IMM

A combination of buffered mode and an Immediate (IMM) bit of one, indicates that the Target will end the command and return status as soon as the tapemark blocks are written into the data buffer. If the Immediate bit is set to zero, the Target will not return status until the Write operation has completed. This will be true even in buffered mode. Any buffered data and tapemarks will be written to the medium prior to completing the command.

Number Of Tapemarks

This field specifies the number of tapemarks to be written. A zero value will write no tapemarks. This can be used to force any buffered write data or tapemarks to be written to the tape. When this field is zero the Drive will not return status until all data and tapemarks have been written (the IMM bit is just ignored in this case). The range of legal values is 0..16777215.

32.3. Terminating Write Operations

See the WRITE command section.

32.4. Write Filemarks from BOM

See the WRITE command section.

32.5. Exception Handling

32.5.1. General

See sections on *Error Conditions For All Commands*, *Deferred Errors* and *Error Conditions For Media Access Commands*.

If the Drive is in unbuffered mode and IMMEDIATE bit is set to one, the Drive will terminate the WRITE FILEMARKS command with CHECK CONDITION status. The Error Code will be set to INVALID FIELD IN CDB. The logical tape position will not be changed.

If both the IMM and the Link bits are set to one the Drive will terminate the WRITE FILEMARKS command with CHECK CONDITION status. The Error Code will be set to INVALID FIELD IN CDB. The logical tape position will not be changed.

When the WRITE FILEMARKS command has started execution, all detected errors will set the VADD bit and the Information Bytes will hold the difference between the requested and the actual tapemark count. See the following sections for details.

If the inserted cartridge is write-protected, the WRITE FILEMARKS command will be terminated with CHECK CONDITION status. No tapemarks will be written. The Error Code will be set to WRITE PROTECTED. This will be true even if the requested number of Tapemarks is zero.

32.5.2. Illegal Media Type

When an illegal combination of medium type and drive is detected, the Drive will terminate the WRITE FILEMARKS command with CHECK CONDITION status. The Error Code will be set to INCOMPATIBLE MEDIUM INSTALLED. No tapemarks will be written.

See the WRITE command (Table 30-2) for illegal media/format combinations.

32.5.3. Illegal Append Tape Format

When appending data on a pre-recorded tape the only legal tape format is the format found on the tape. If the format set by the MODE SELECT command is not equal to the tape format, the Drive will terminate the WRITE FILEMARKS command with CHECK CONDITION status. The Error Code will be set to INCOMPATIBLE MEDIUM INSTALLED. No tapemarks will be written.

32.5.4. Logical Early Warning

If logical early warning (LEW) tape marker is reached during the execution of a WRITE FILEMARKS command, the Drive will respond as described below:

- *The Drive will attempt to write all buffered tapemarks. The WRITE FILEMARKS command will then be terminated with CHECK CONDITION. If all tapemarks and data in the buffer were successfully written to the tape, the Error Code will be set to END-OF-PARTITION/MEDIUM DETECTED ON WRITE, LEW PASSED. The EOM and VADD bits will be set to one. The Information Bytes will be set to zero.*

  The Drive will force unbuffered mode (regardless the state of the BM bit in the MODE SELECT/SENSE Parameter List).

- *If a read type command (READ, LOCATE, SPACE or VERIFY), has brought the tape past the LEW marker and an Append Operation is attempted, then the Drive will terminate the first WRITE FILEMARKS command immediately with CHECK CONDITION. No tapemarks will be written. The Error Code will be set to END-OF-PARTITION/MEDIUM DETECTED ON WRITE, LEW PASSED. The EOM and VADD bits will be set to one. The Information Bytes in the sense data list will be set equal to the requested transfer length.*

  The Drive will force unbuffered mode (regardless the state of the BM bit in the MODE SELECT/SENSE Parameter List).

- *If another WRITE FILEMARKS command is received by the Drive while the tape is positioned after LEW (but before end of partition), the Drive will transfer and write all requested data if possible. The WRITE FILE-MARKS command will then be terminated with CHECK CONDITION (this will be true even if the requested Number of Tapemarks is zero). If all tapemarks were successfully written to the tape the Error Code will be set to END-OF-PARTITION DETECTED ON WRITE, LEW PASSED. The EOM and VADD bits will be set to one. The Information Bytes will be set to zero.*

32.5.5. End of Partition

If end of partition is reached during the execution of a WRITE FILEMARKS command, the Drive will terminate the command with CHECK CONDITION status. The Error Code will be set to END-OF-PARTITION/MEDIUM DETECTED ON WRITE, PHYSICAL END REACHED. The Valid (VADD) and End Of Media (EOM) bits will be set to one.

The Information Bytes in the sense data list will be set to the difference between the requested number of tapemarks and the actual number of tapemarks transferred to the Drive's data buffer.

This error condition has priority over the Logical Early Warning error condition.

Additional WRITE FILEMARKS commands issued after an end-of-partition error has occurred will be terminated immediately with a CHECK CONDITION (no tapemarks will be transferred). The end-of-partition condition will persist until a position type command has been executed (ERASE, LOAD/UNLOAD or REWIND).

32.5.6. Non-Recoverable Write Error

If a non-recoverable write error occurs, the Drive will terminate the WRITE FILEMARKS command with CHECK CONDITION status. The Error Code will be set to EXCESSIVE WRITE ERRORS. The Valid (VADD) bit will be set to one.

The Information Bytes in the sense data list will be set to the difference between the requested number of tapemarks and the actual number of tapemarks transferred to the Drive's data buffer.

This error condition has priority over the Logical Early Warning error condition.

Additional WRITE FILEMARKS commands issued after a non-recoverable write error has occurred, will be terminated immediately with a CHECK CONDITION (no tapemarks will be transferred). The non-recoverable write error condition will persist until a position type command has been executed (ERASE, LOAD/UNLOAD or REWIND).

32.5.7. Append Error

When the WRITE FILEMARKS command is executed after a READ, LOCATE, SPACE or VERIFY command, or after a WRITE FILEMARKS command where the data in the drive internal buffer has been flushed to the tape, the Drive must seek the last block on the tape before the write operation starts. In all these situations an End Of Data marker will identify where the last block transferred is located on the tape. If this seek operation fails, the Drive will terminate the WRITE FILEMARKS command with a CHECK CONDITION status. The Error Code will be set to WRITE APPEND POSITION ERROR. The Valid (VADD) bit will be set to one.

The Information Bytes in the sense data list will be set to the difference between the requested number of tapemarks and the actual number of tapemarks transferred to the Drive's data buffer.

The EOD marker will reside on the tape, ensuring consecutive read operations to terminate with END OF DATA DETECTED. The Append Error condition has priority over the Logical Early Warning error condition.

Additional WRITE FILEMARKS commands issued after a non-recoverable write error has occurred, will be terminated immediately with a CHECK CONDITION (no data will be transferred). The append error condition will persist until a position type command has been executed (ERASE, LOAD/UNLOAD or REWIND).

32.6. Phase Sequencing

In this section the possible SCSI-bus phase sequences during execution of the command are described. Section 3.2 has more details about the generic phases in the brackets.

<sequence 1> := <initiator-part> <message-out> <command> <disconnect> <reconnect> <completed>.

This sequence is used when disconnection is allowed.

<sequence 2> := <initiator-part> <message-out> <command> <completed>.

This sequence is used when disconnection is not allowed.

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